INTERAVIA

REVIEW OF WORLD AVIATION

IN THIS ISSUE

Across the Bridge to Moscow

The Pentagon Dispute

Naval Air Power

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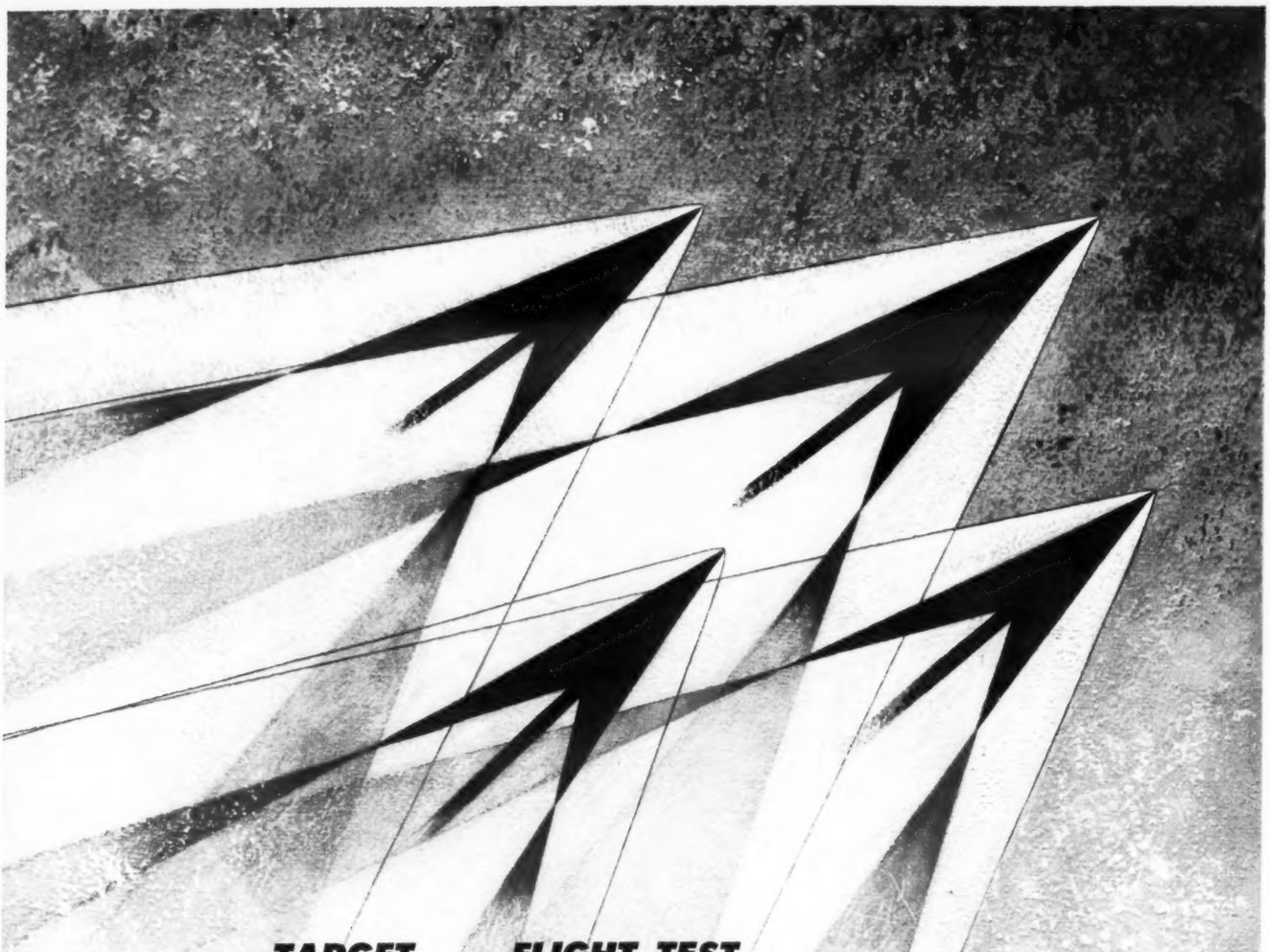

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Within a few months, Sabres powered by Orendas will go into service as the South African Air Force's first-line fighters.

Wave patterns interpreted from a wind tunnel photograph of the ORENDA arrow at 1800 miles an hour. Institute of Aero Physics, University of Toronto

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INTERAVIA

Review of World Aviation

Volume XI — No. 8 — August 1956

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Front Cover :

"Combat air patrol" (CAP) is the Navy term for the fighter cover which naval interceptors fly to protect their own aircraft carriers. The aircraft shown here are North American FJ-3 Furies flying over the first of the U.S. Navy's 60,000-ton strategic attack carriers, CVA-59 Forrestal.

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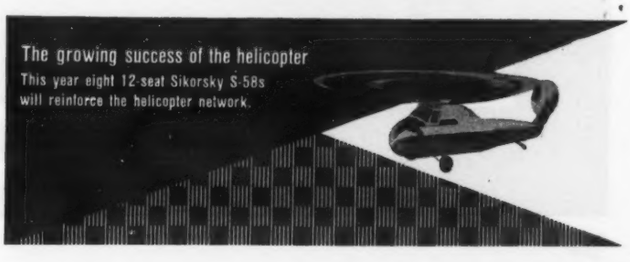
renews its fleet...
Perfect comfort in the air
This year 12 Convair Metropolitans will be put into service on the European network
More than 5,000 miles range...
By 1957 nine four-engined DC-7C "Seven Seas" will operate the long-distance routes
Flying time cut by half
By 1959 four Boeing jet Stratoliners will place New York within 6 hrs. 40 mins. and Leopoldville within 7 hrs. 50 mins. of Brussels.
All 3 equipped with R.C.A. NOSE RADAR which sees the route up to 150 miles ahead



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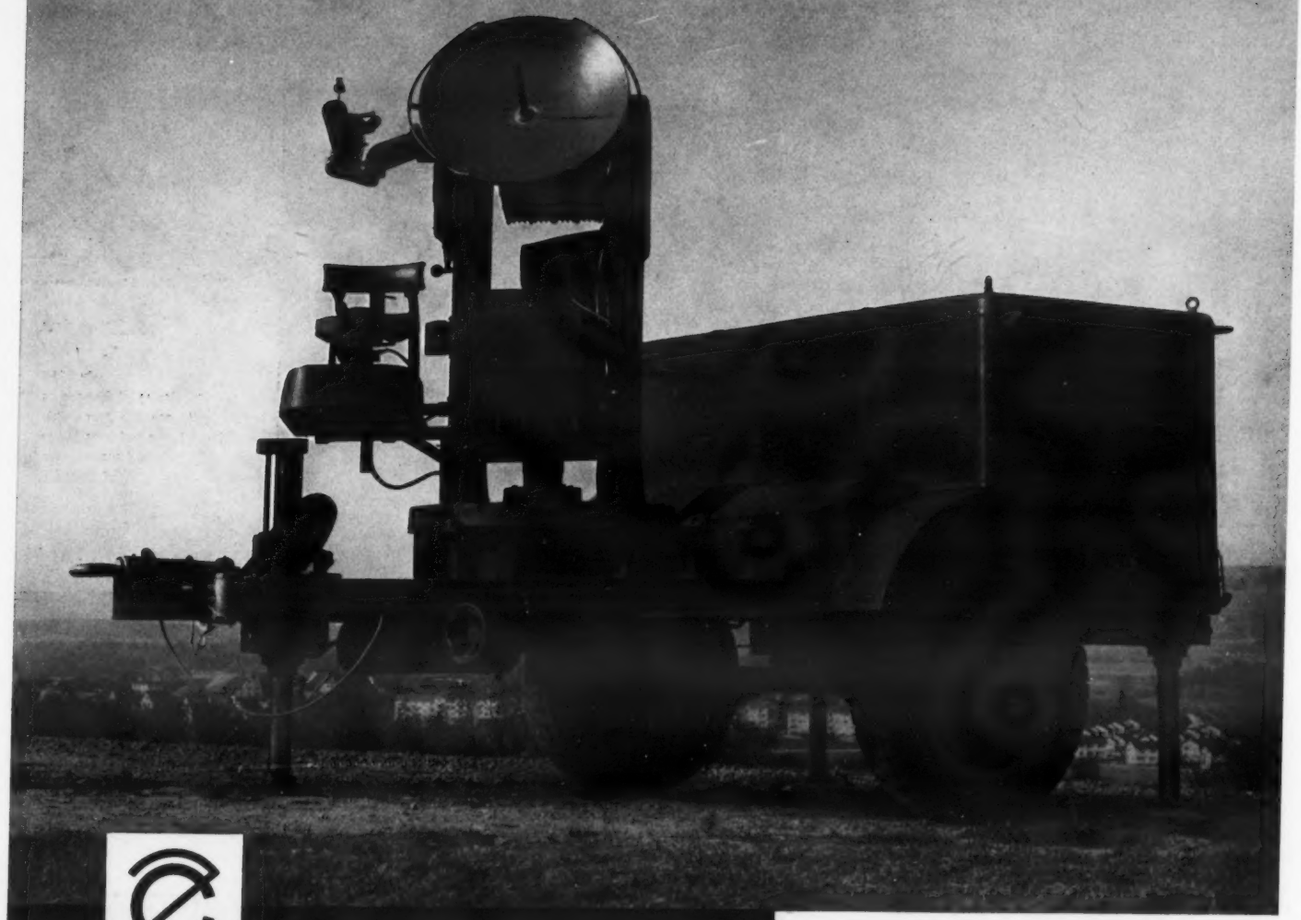
For 40 mm A. A. Batteries

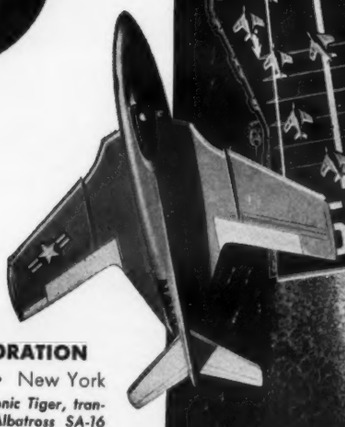
consisting of: MLT-5B Fire Control Radar Set (MICROLAMBDA, ROMA) for target acquisition and for automatic tracking, optical tracker and electronic computer with a total weight of less than 3 tons. / Simplified operation. / High mobility and quick emplacement. / Quick computation of gun data with maximum accuracy. / Training of maintenance personnel has been simplified considerably through the application, wherever possible, of techniques and components similar to those employed in the design of the Contraves F/90 Director.



CONTRAVES ITALIANA S. p. A. ROMA

PROGRESS NEEDS PROTECTION

The mighty Forrestal can protect a center of progress like New York City while oceans away.
The threat of retaliation from this swift, roving airbase is another powerful deterrent to any country's thought of aggression.
For the deck of this super-carrier can launch a hundred jets to strike with sudden devastation.
The Forrestal is, with the atomic submarine, an example of U. S. Naval progress in protection.
So, too, are the Grumman Cougars on the Forrestal flight deck. Cougars, like all Grumman airplanes, were ready in quantity when needed.



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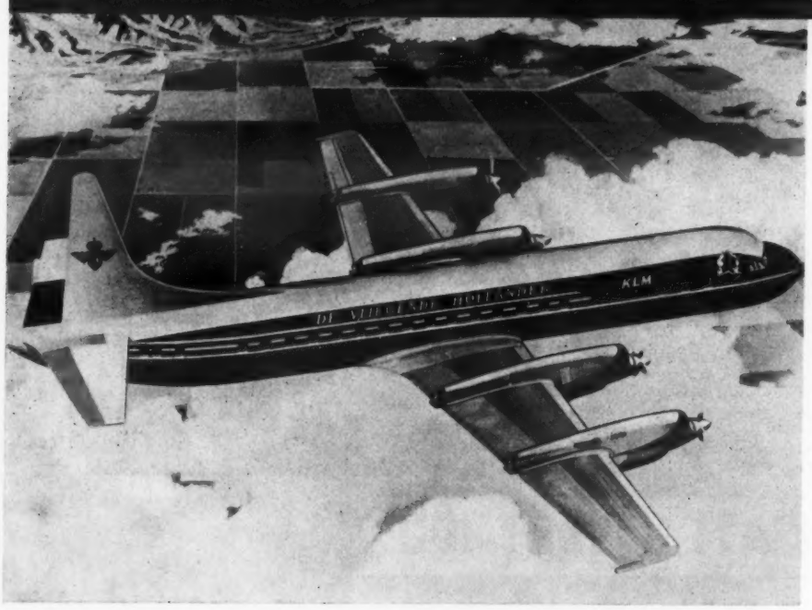
Around the World

FOURTEEN AIRLINES in 11 countries have ordered the newest Douglas transport, the DC-7C. All of the 117 aircraft now on order will be equipped with Hamilton Standard reversible Hydromatic propellers with aluminum alloy blades. Airlines which have placed these orders are Braniff International Airways, Northwest Orient Airlines, Pan American World Airways, British Overseas Airways Corporation, Alitalia, Cia. Mexicana de Aviacion, KLM Royal Dutch Airlines, Panair do Brasil, Sabena Belgian World Airlines, Scandinavian Airlines System, Swissair, Real-Aerovias Brasil, Japan Air Lines, and Compagnie de Transports Aériens Intercontinentaux.

With a 5,000-mile range, the DC-7C can fly nonstop westbound across the Atlantic against prevailing winds, or across the Pacific. Record-making nonstop flights have already been made by Pan American World Airways from Miami to Paris, 4,800 miles in 13 hours, 55 minutes, and from Frankfurt to New York, 4,060 miles against headwinds in 13 hours, 15 minutes.



A NEW TYPE of Hamilton Standard propeller designed for turbine engine installations has been specified by KLM Royal Dutch Airlines for its 12 Lockheed *Electra* propeller-turbine transports. Featuring several important advances in design, the propellers are reversible Hydromatics with hollow aluminum blades. Simple hydromechanical controls improve coordination between engine and propeller, and give greater flexibility in ground operations. Another Hamilton Standard product, known as a "Synchrophaser", will be used to minimize propeller noise and vibration.

with United Aircraft

LARGE, TWIN-ENGINED HELICOPTER above, the Sikorsky S-56, can carry 26 passengers and baggage. The first delivery flight of a production model of this helicopter has been made to the U.S. Marine Corps, which designates this model helicopter the HR2S. Two Pratt & Whitney Aircraft Double Wasp engines similar to the 2,500 hp engine in over a thousand modern airliners power the huge helicopter, which has retractable landing gear. Its design, range, and payload reflect significant advances in helicopter design and production. Quantities are on order by both the U.S. Marine Corps and Army.

U.S. JET TRANSPORTS ORDERED BY 16 AIRLINES

Sixteen leading airlines around the world have ordered fleets of U.S. jet transports, either Boeing 707s or Douglas DC-8s. Both types will fly with JT3 or JT4 turbojet engines made by Pratt & Whitney Aircraft. They will enter service starting in 1959. The lines which have ordered the new transports include:

Pan American World Airways
United Air Lines
National Airlines
American Airlines
KLM Royal Dutch Airlines
Braniff International Airways
Eastern Air Lines
Continental Air Lines
Air France
Sabena Belgian World Airlines
Panagra
Swissair
Trans World Airlines
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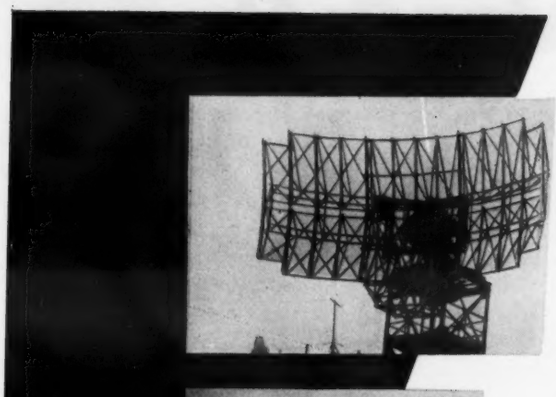

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FASTEST — Top speed will exceed 400 mph. Maximum cruising speed around 350 mph. Point to point speed up to 70 mph faster than any other piston-powered aircraft at ranges beginning at 4200 miles. The four Wright turbo-compound engines produce 13600 HP, a new high for this type of engine.

QUIETEST — Lockheed designers took two steps to give the plane a new degree of flying quietness. Relocation of the engines 1,5 m farther from the fuselage and use of larger, slower revolving propellers.

LARGEST — Largest wing and longest passenger space of any airliner in service. Luxury interior with roomy sleeping accommodation; also increased cargo capacity.

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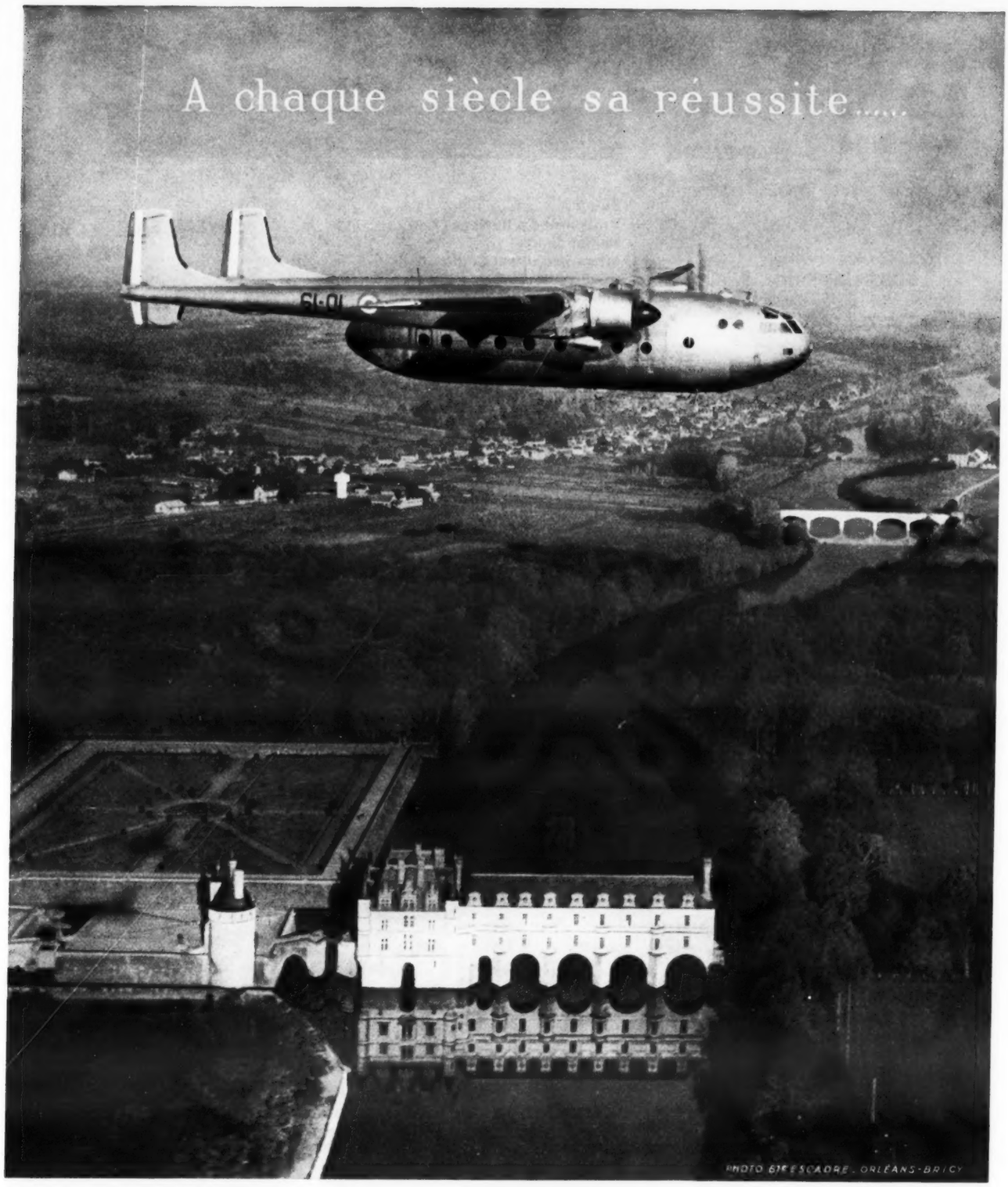

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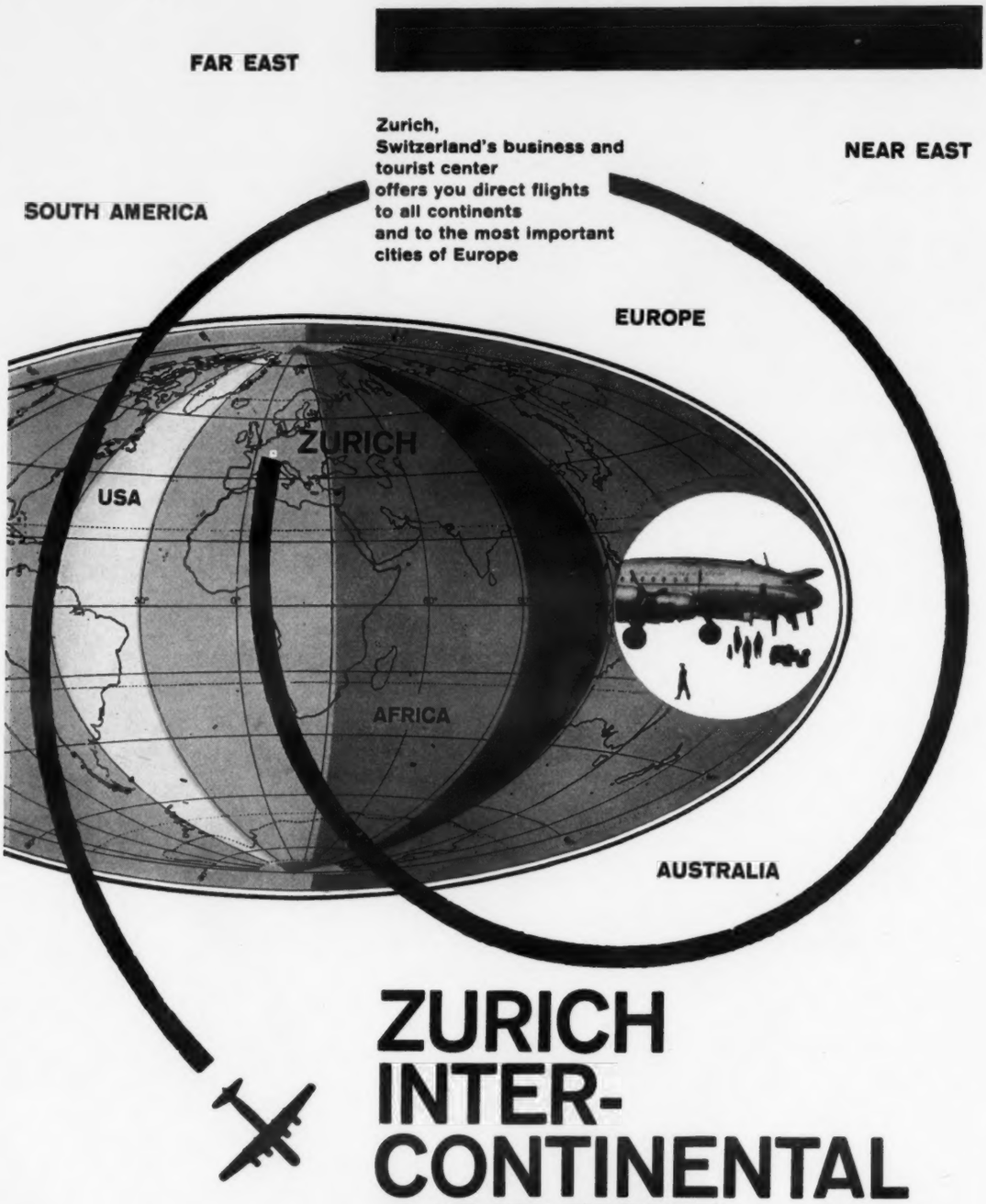

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Flygmotor
Sweden's future air defence will rely on the new supersonic Saab J 35, all-weather fighter. This plane is powered by a powerful late-model Rolls Royce Avon engine, built – like practically all the powerplants used by the Swedish Air Force during the past 25 years – by Flygmotor.

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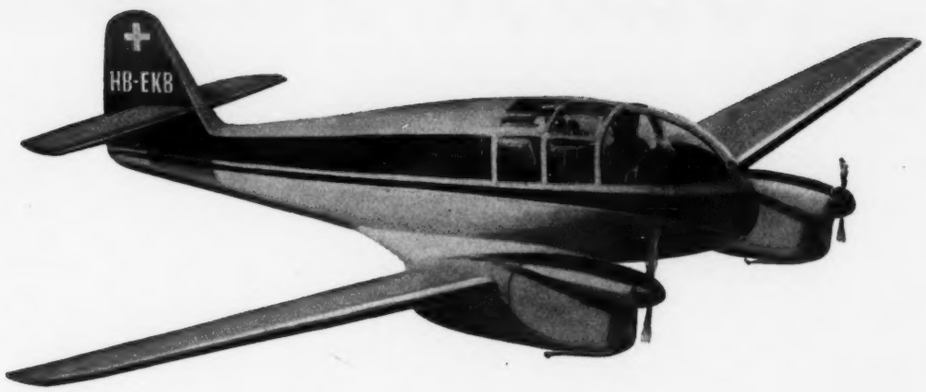

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Personally speaking

—a series of contributions on questions of the hour by leading international aviation personalities.

LORD DOUGLAS OF KIRTLESIDE
G.C.B., M.C., D.F.C.
—Chairman of BEA and President-Elect of IATA. A pioneer airline Captain (1919) and Marshal of the R.A.F., makes this contribution on . . .

IATA

In an age bemused by a mass of initials—UNO, NATO, OEEC, BEA, BOAC, TWA, ICAO—the public must be forgiven for failing to become excited by IATA. Yet the International Air Transport Association is in reality a body of immense interest, and a stirring example of practical international co-operation. It is a free association of over seventy leading airlines of the world.

IATA came into its own after the second world war, and in the last ten years its member airlines—including BOAC and BEA, of course—have made remarkable progress. They are carrying 23 times as many passengers, 70 times as much cargo and 13 times as much mail as they did in 1946. Nearly 70 million people travelled on the air routes of the world last year, and 2½ million of them passed through London Airport.

IATA stands for joint planning and joint action, the ordered compromise that results from agreement reached round the council table, the rationalisation of air transport everywhere to the highest standards of safety and service.

Man's progress in the air is an exciting affair, naturally associated with youth and adventure. It is now more than that—an essential part of life and commerce, drawing people closer together in terms of space, time and understanding. IATA plays a leading part in this, and as President-Elect I am happy to declare my faith in its future service to the peoples of the world.

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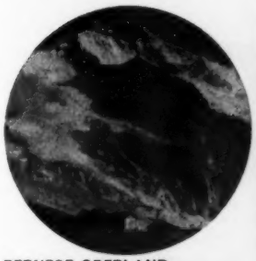

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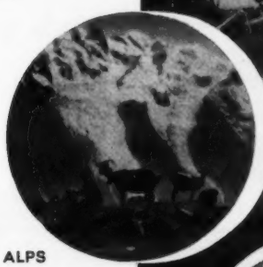

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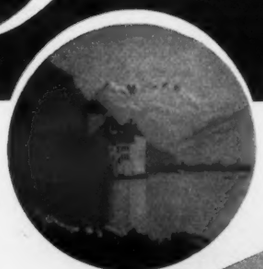

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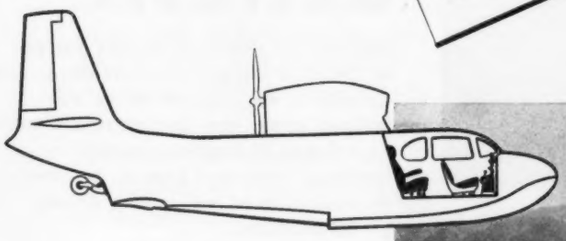

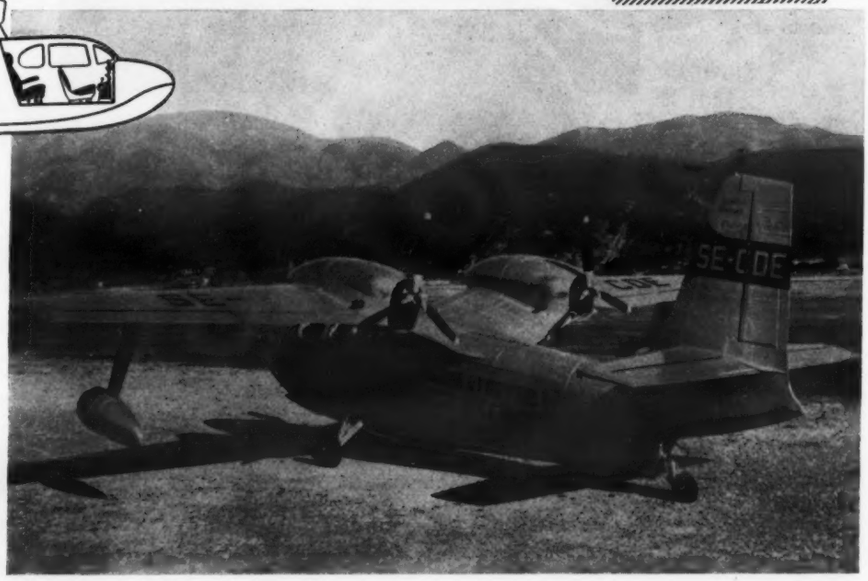

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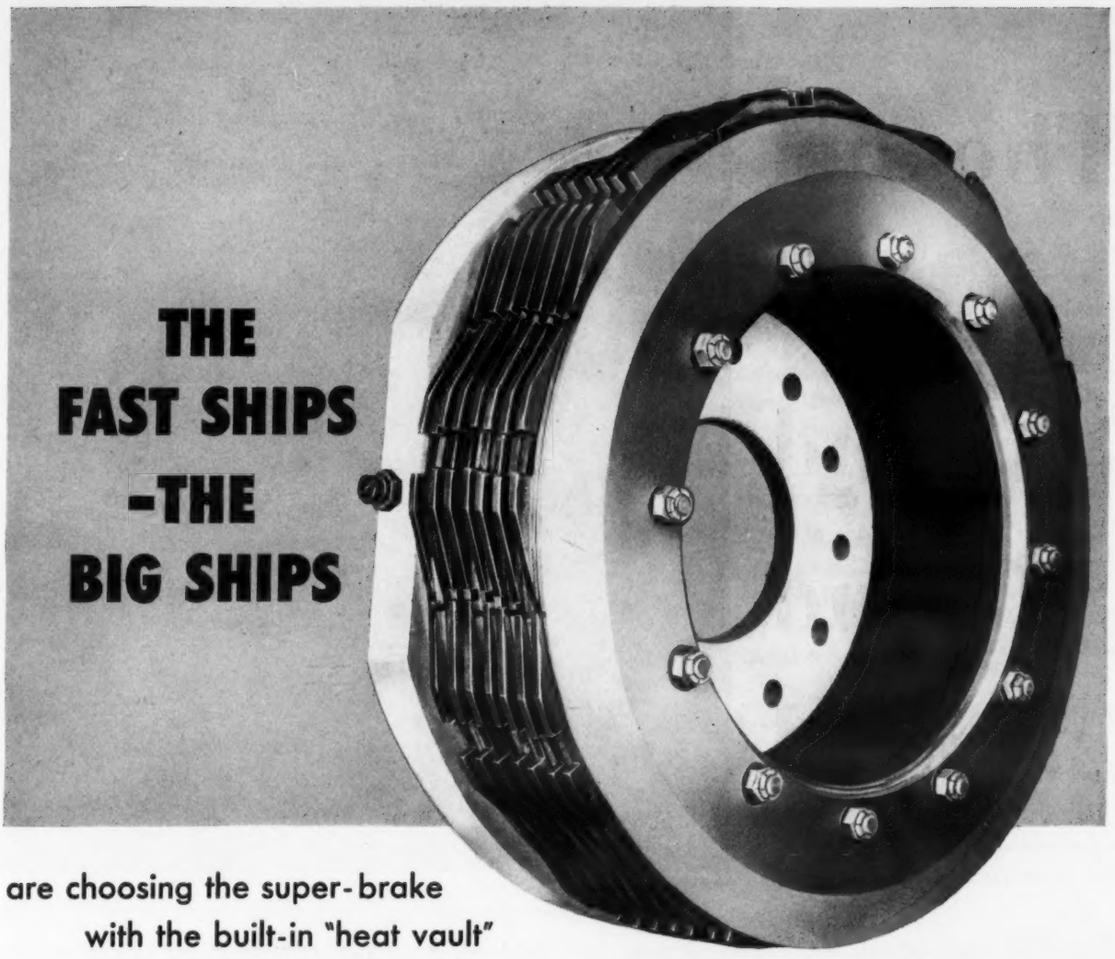

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with the built-in "heat vault"

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If your brake problem would be simplified by these qualities—then by all means get the facts on this new brake. Write: The Goodyear Tire & Rubber Export Company, Aviation Products Department, Akron 16, Ohio, U.S.A., or The Goodyear Tyre & Rubber Company (Great Britain) Ltd., Wolverhampton, England.

GOODYEAR
AVIATION
PRODUCTS

The fuel goes 'round and around

Between the arms of this ENGLISH ELECTRIC test rig at Warton there is room to put the fuel system of a modern jet aircraft—full size, and complete with all tanks, pipes, pumps, vents and cocks.

From the tanks can be pumped fuel at any desired rate up to that representing the full throttle take-off condition. Into it can be pumped simultaneously enough fuel to keep the level at any required point—thus maintaining steady conditions of test.

And while all this pumping and counter-pumping is going on, the entire outfit can be rotated bodily through any required angle, at any required rate of rotation (within limits), thus simulating as nearly as may be the effect on the fuel system of high-speed manoeuvres in flight.

If the test rig proves that the calculations of the ENGLISH ELECTRIC test team were correct—well and good. If not—how much better that defects should be shown up on the ground than in the air! In this open-minded atmosphere the long, costly and elaborate testing on the ground does a lot to shorten the much longer, and certainly more dangerous, process of trial and error in the air.

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Design starts from an attitude of mind

INTERAVIA

Deadline Notes

No. 8, 1956

DE HAVILLAND AIRCRAFT CO. LTD. has received an order from the U.S. domestic carrier Capital Airlines, for fourteen Comet IV and Comet IVA jet airliners, to a total value of £19,000,000. For de Havilland the contract is the first big news after several difficult years, since hitherto, despite its pioneering efforts in the jet transport field, the company had received orders for only 19 improved Comets for B.O.A.C. The Comet sale means that a second British airliner, after the Vickers Viscount, has invaded the American market.

BRITISH EUROPEAN AIRWAYS, following the example set by Capital Airlines, is considering the purchase of four or six Comet IVA medium-range aircraft, according to unconfirmed reports from London.

THE U.S. OFFICE OF AVIATION SAFETY daily receives and analyses flight control reports from all over the world. Through the cooperation of U.S. airlines, news of every significant malfunctioning of aircraft or engines is examined, edited, mimeographed and dispatched by airmail to all users of transport aircraft. Using the Summary of Daily Mechanical Reports, each airline inspects its own aircraft for faults similar to those reported by other companies. These hints often help to prevent costly breakdowns and delayed schedules. The number of DMR items received daily averages eight to ten.

THE CANADIAN AIR LINE PILOTS ASSOCIATION has submitted a brief to the Transport Minister advocating the establishment of a separate Air Ministry in Canada and claiming that the Department of Transport is too over-worked to plan adequately for the future of Canadian aviation. The Association had already caused something of a stir last April when it criticized the Distant Early Warning line airlift.

THE ARGENTINE GOVERNMENT has issued a decree authorizing private Argentine airlines to compete with the State-owned Aerolineas Argentinas in both national and international air passenger and freight traffic. Hitherto the Government airline has held the monopoly.

THE U.S. AIRCRAFT INDUSTRY has been cleared of the suspicion that it makes excessive profits. A House Armed Services Committee which for the past year has been conducting an inquiry into 166 Government contracts held by the United States' 12 major aircraft manufacturers has found that profits on Navy orders range from 7 to 10%, on Air Force orders from 8 to 9%. Additional tax adjustments would more than account for what may appear, in a few instances, to be overpayment, it concluded.

LOCKHEED AIRCRAFT CORPORATION'S ORDER BACKLOG for commercial aircraft totalled $465,000,000 at the end of July, more than double the figure for mid-1955. Foreign airlines bought 25 Lockheed transports in the first six months of the year - virtually half of the total of 52 airliners and civil cargo aircraft, worth $130,000,000, which were purchased during this period. Sales included 33 turboprop Electras, ten L-1649A Super Constellations, six L-1049H cargo Super Constellations and three L-1049G Super Constellations. The current backlog of 230 transports, which will extend civil production through 1960, raises the number of Lockheed airliners sold since the end of World War II to 601.

AERONUTRONIC SYSTEMS INC., the new subsidiary of Ford Motor Co. founded in May for research and development in the guided missile and space travel field, has leased the Grand Central Terminal buildings in Glendale as temporary headquarters.

S.N.C.A. DU SUD-EST will be known as Sud-Est Aviation, Société Nationale de Constructions Aéronautiques, from August 28th. On the same date, the company's headquarters and management will move to 37 Boulevard de Montmorency, Paris 16e, Tel. BAGatelle 84-00.

FLUGZEUG-UNION SUED GmbH is the name of a new group enterprise founded by Messerschmitt AG, Augsburg, and Ernst Heinkel AG, Stuttgart, with head office in Munich (cf. "What's in the Air?" in this issue). The group is to receive an order for production of Fouga Magisters under licence for the German Air Force.

SVENSKA AEROPLAN A.B. is to build 25 Saab 91B Safir trainers for the Norwegian Air Force at its Linköping plant. - Norway is the third country, after Sweden and Ethiopia, to introduce the Safir as standard trainer for its Air Force.

* From INTERAVIA's world-wide news service, including INTERAVIA AIR LETTER, the daily international aviation news digest. — No part may be reproduced without written permission.

CANADIAN CIVIL AVIATION IN 1955: Canadian air carriers made a net operating profit of $6,162,483 during 1955, the Dominion Bureau of Statistics revealed in its recently preliminary annual report for the year. This figure represents an increase of $4,285,563, or 228.3 percent over the $1,876,920 reported in 1954. It was the fifth successive surplus in as many years. - The number of passengers carried by Canadian airlines in revenue services rose to 2,711,352 from 2,316,655, an increase of 394,697 or 17 percent over the previous year. The number of revenue passenger miles performed showed a gain of 14.9 percent, rising to 1,175,339,948 from 1,023,-134,596 in 1954. The amount of revenue freight carried totalled 222,224,900 lbs., almost double the quantity reported in the preceding year. The increase in bulk transportation from 63,140,902 lbs. in 1954 to 172,728,-233 lbs. in 1955 was largely responsible for this gain. Canadian carriers flew a total of 48,590,095 revenue miles during 1955, in addition to 31,860,748 miles flown in the performance of bulk transportation services. This compares with 42,564,118 miles and 16,755,073 miles respectively in 1954.

"OPERATION ALERT 1956" in late July was the biggest civil defence exercise ever to be held on the North American Continent and was based on a simulated nuclear attack on both the United States and Canada. The point of the hypothetical mass attack was to train as many people as possible in civil defence operations at local, state and national levels, and to perfect communications among the various Government departments and between the Government and the public. In the United States key Federal officials and thousands of Government workers shifted their headquarters from Washington to some thirty secret locations 50 to 350 miles away. Some of the 75 target localities held test evacuations.

CUBI POINT NAVAL AIR STATION, a new U.S. base on Bataan Island in the Philippines, was commissioned on July 25th. The $80,000,000 airfield is to have a 8,000-ft. concrete runway capable of handling America's biggest atomic bombers. To build this new naval air station, which is located about 50 miles northwest of Manila, a 1,200-ft. mountain was moved. Construction work has been in progress for five years and is still not completed. Installations include a carrier dock.

THE JAPANESE DEFENCE AGENCY has submitted to the U.S. military authorities a research and development plan for providing Japan's armed forces with new weapons. If the plan, which was drawn up by the Defence Agency's Technical Research Institute, is approved by the U.S. authorities, technical and financial aid will be given by the United States under the military assistance agreement with Japan. Important weapons listed in the plan include: 1- 105-mm recoilless self-propelled guns; 2- medium-size tanks; 3- an anti-submarine device known as "C" locator which can detect completely submerged submarines; 4- homing torpedoes; 5- long-distance radar for use against submarines; 6- light jet trainers; 7- air-to-air rockets.

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WORKSHOP BRIEFS . . .

The first KC-135 jet tanker rolled off the assembly line at Boeing's Renton, Seattle, plant in mid-July . . . 21 months and 13 days after award of the contract. * British European Airways has taken delivery of the first Bristol 173 twin-engine helicopter with tandem rotors. The machine has accommodation for 12 to 14 passengers. * The Deutsche Arbeitsgemeinschaft für Raketentechnik (German Rocket Engineering Working Group) in Bremen is making bench tests on the power plant for a meteorological rocket and a so-called supply rocket. The body of the meteorological rocket, which is to be used for weather observations at high altitudes, is being tested in the DVL wind tunnel at Aachen. * A new, more powerfully armed version of the Northrop Scorpion twin-jet all-weather fighter, the F-89J, is undergoing firing tests at Holloman Air Force Base, New Mexico. * The Dassault Etendard II and Etendard IV light ground attack aircraft have begun flight testing. * The U.S. Navy Bureau of Aeronautics has awarded the Columbus Division of North American Aviation a contract for development of a two-seat jet trainer for basic military training. Type designation: North American T2J; power plant: one Westinghouse J-34 of 3,400 lbs. thrust. Max. speed 400+ knots, stalling speed 65 knots. * A six-year plan for development and production of a Japanese-designed commercial transport has been prepared by the Ministry for International Trade and Industry. The aircraft would be powered by two turboprops of 2,400 to 2,600 h.p. each (probably Rolls-Royce Dart RDa.8s) and would carry a crew of three plus 40 to 50 passengers. Span about 100 ft., cruising speed approx. 300 m.p.h., range 1,500 miles, gross weight 40,000 to 50,000 lbs. * Final assembly of the Fiat G.91 is making good progress, so that the first flight can be expected before the end of the summer. * Boeing KB-50 tankers are to be fitted with two General Electric J-47 auxiliary jet engines to improve performance. The jets will be suspended in pods underneath the wing, as in the P2V-7 Neptune. * A new high-performance jet engine, the X-207, is under development at General Electric. * The French firm of SIPA is working on a twin-engine observation and multi-purpose aircraft, the SIPA 1100, specially suited to operations in France's overseas possessions. Two 600 h.p. Pratt & Whitney R-1340 piston engines; shoulder-level wing and retractable tail-wheel undercarriage.

* * *

Are They Finally Getting Together?

In October of last year the writer of these lines had the honour of meeting James H. Smith, Jr., Assistant Secretary of the Navy (Air), at the Pentagon in Washington. Smith, a naval aviator for nearly a quarter of a century, who fought throughout the Pacific war, is an impressive personality. Originally a lawyer, he became a front-line officer and after the war, a Vice-President of Pan American World Airways. Thus, he knew something about flying. Later on I heard, without being able to check, that he is deeply interested in the fine arts and that, for instance, he knows quite a lot about modern French painting. A very pleasant person.

He and his Naval Aide, Captain T. H. Moorer, U.S.N., showed great zest in defending the roles and potential of naval aviation, and their arguments carried much weight. And thus it was agreed at the Pentagon that in the course of this summer *Interavia Review* would discuss certain *problems of naval aviation* in somewhat greater detail.

What it was not possible to foresee at the time were the events of recent weeks, the squabbles between the U.S. Air Force, the U.S. Army and the U.S. Navy, which on occasions became quite heated. That the three Services are envious of each other's bread baskets — the Air Force's has become consistently heavier in the last few years under the "New Look" policy of American strategy—is an old story. However, as soon as Senator Stuart Symington, Chairman of an air power investigation sub-committee of the Senate Armed Services Committee, began to enquire whether the Administration had not made mistakes in the allocation of materiel procurement funds, the whole affair quickly outgrew purely technical considerations and became a matter of personalities. One result was that at the end of May 1956 Assistant Secretary Smith tendered his resignation, and Garrison Norton was nominated to succeed him. Certain American sources claim that even the energetic Secretary of Defense, Charles E. ("Engine Charlie") Wilson, will retire from his post in the near future.

Admittedly, the affair is of importance primarily to the United States. However, the Western World—whose leader America is today—as well as the Eastern bloc necessarily are also interested in these discussions. It was therefore indicated to include in the present issue an article by *Interavia's* Study Group on this controversy about a strategic concept, as a kind of introduction to a series of features dealing with naval air matters as such—and it is hoped that readers will enjoy the galaxy of naval pictures. An introduction of this sort was not envisaged in October of last year. But the dispute in question is not merely a typically American problem but affects the organization of armed forces all over the world.

So much for naval air operations and all the auxiliary questions to which a large section of this issue is devoted.

*

Other events occurred in June 1956 as well.

As a mere aside we may recall that a heated battle was fought at I.A.T.A. Traffic Conference at Cannes over the new North Atlantic passenger fares. The matter ended in a compromise and the Americans seem to have won their point—even though the Europeans had previously proclaimed that any kind of tariff reduction would be the ruin of air transportation. Furthermore, the fact that the I.C.A.O. General Assembly last month at Caracas, Venezuela, had to allocate even more time than first scheduled to problems of air safety can be traced to the tragic, but theoretically not at all improbable, first mid-air collision of two large airliners over Arizona. All these things are important to air transport.

However, for aviation circles all over the world, and possibly even for international politics, the opening of the "first bridge to Moscow" may well be much more significant.

The writer of these lines would have liked to go to Caracas himself and was no less tempted to go to Moscow. But his years and health were against the two trips, and he therefore contented himself with watching the two important events through a telescope, so to speak. From his group of collaborators of many years he sent the ablest diplomat to Venezuela, while a first-rate engineer and a "photographically talented" experienced reporter went to Moscow. The first report on the Moscow aviation days by our two Special Correspondents will hardly disappoint *Interavia's* curious readers, for it is factual, and neither the story nor the photographs have been touched up.

From statements made by Guest Number One at Tushino, General Nathan F. Twining of the U.S. Air Force, the world's press has drawn conclusions which may be accurate or not. It is said that General Twining was not disappointed with his trip to Moscow—it is likely that he did not expect to see more than he did. The Russians certainly did not unveil their latest, secret developments, and of ballistic missiles there was no sign. What they demonstrated in the air and on the ground was conclusive proof that in the past five years the Soviet Air Force has made great progress both in the design of airframes and engines. Whether they are equally advanced in the field of equipment, particularly electronics, is a matter for speculation.

Twining's report may have suited some Americans and disappointed others. The Soviet Air Force is good, he is quoted as having said in substance, but for the time being the U.S. Air Force still has the edge. Of a different opinion seems to be Senator Symington, according to whose evidence "Engine Charlie" has not done enough for the U.S.A.F.'s Strategic Air Command, while the U.S.A. is lagging behind the Russians in the development of the long-range ballistic missile. It seems, however, that both antagonists—Wilson and Symington—are at sea so far as Russian long-range weapons development is concerned, for in Moscow these weapons stayed strictly out of sight. The exuberant First Communist Party Secretary, Nikita Khrushchov, is said to have declared ironically: show us your (latest) aircraft, and we shall show you our rocket missiles . . .

Apart from that the atmosphere in Moscow was quite . . . bourgeois and relaxed. Both the photos distributed by the agencies and brought back by *Interavia's* Correspondents are proof of this. People had a chance of getting together, and even the minor tribulations and annoyances were shrugged off because the people on the banks of the Moskva River were as friendly as any others. And if the images of the equipment shown are not as sharp as those of the leading personalities, this was partly due to the weather which may improve by next year.

*

Now that conversations between East and West have started in a manner more friendly than most of us had dared hope as little as a year ago, there even appears a possibility that the talks between the military staffs of East and West may become more conciliatory and that the new concept of co-existence will find its way also into inter-service relations. At any rate, coincidence has once again played a role in *Interavia's* editorial work: we had planned to write about naval aviation, were forced to report on the New Look of the West's armament policies and had a chance—thanks to the courtesy of the Russian authorities—to mingle with those pilgrims who for the first time were allowed officially to cross the bridge to Moscow.

EEH

Getting together in Moscow... Left to right: Party Secretary N. S. Khrushchov; an interpreter; General Nathan F. Twining, Chief of Staff, U. S. Air Force.

The First Bridge to Moscow

Personal report on the Tushino Air Display by Interavia's Special Envoys to Moscow

Karasho . . . okay! There we were on the rain-soaked grass at Moscow's Tushino sports airfield, wiping the raindrops out of our eyes. It was Sunday, June 24th—year One of Co-existence—and shortly before 10 a.m. Moscow time. The flying display to celebrate Soviet Aviation Day was due to begin in a few minutes. But would the show take place? The cloud ceiling was barely 3,000 ft., and it was pouring with rain.

How we got to Moscow and what we saw there—apart from aircraft—is another story. We shall content ourselves here with a description of the drive to the airfield.

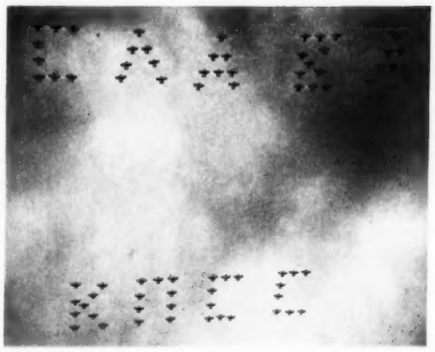
Tushino, seat of the "V.P. Chkalov Central Aero Club"[1], lies about nine miles northwest of the Kremlin, between the Moskva River and the North River Port. Although fairly big, the airfield has no paved runways of any kind, so that it can be used only by small sports and touring aircraft or helicopters. Thus—an important point—none of the aircraft demonstrated, except the helicopters and gliders, took off or landed at Tushino; they came from other fields and simply flew past.

We reached the airfield in a green, five-seater M-20 *Pobieda* belonging to the Red Army, which picked us up at the hotel and drove us to Tushino along the wide Leningrad Chaussee. This thoroughfare had been turned into a one-way street for the occasion and was flanked by large numbers of police. Left and right rode the "fat" ZIS and ZIM cars of the Soviet Government representatives and military delegations and the Chevrolets and Cadillacs of the diplomatic corps (all with large pennants), the smaller *Moskvitches* of senior employees and many trams and busses bursting with spectators. Altogether, something like 200,000 people must have attended the display.

The edge of the airfield was dominated by the Government grandstand, lavishly decorated with flags and large portraits of Lenin and the eleven leading members of the Communist Party's Central Committee. The heads of the U.S.S.R. took up their positions underneath, in the following order from the right wing to

[1] Named after Valery P. Chkalov, the Russian long-distance pilot, who flew non-stop from Moscow over the Arctic to Portland, Oregon (5,300 miles) with two companions in 1937.

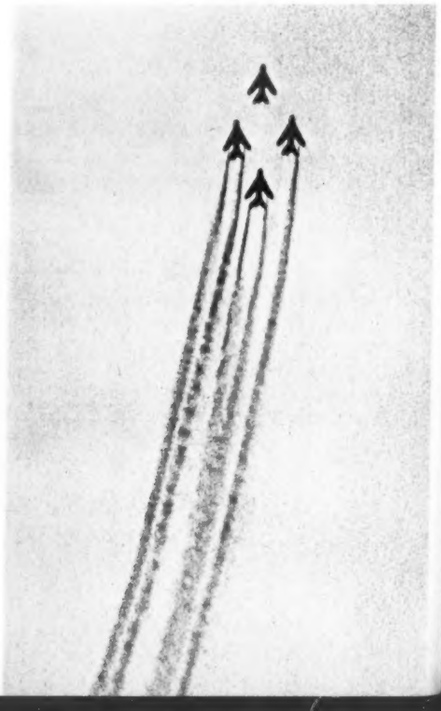
The leading group of banner aircraft (Yak-12s).

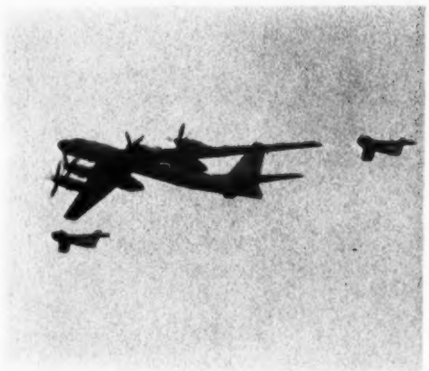


Long live the Party . . . (Yak-18s).

The Government and diplomatic grandstand, lavishly decorated with flags and portraits of Lenin and the eleven leading members of the Central Committee.

MiG-19 *Farmer* jet fighters in precision formation acrobatics, for the first time in diamond formation.





The leading group of "heavyweights": Tupolev *Bear* turboprop long-range bomber and anti-submarine aircraft, flanked by two Mikoyan MiG-17 jet fighters.

Two *Bears* from the following formation of three. Note the bulge under the nose for the radar search equipment (H2S) and the gun post in the rear. Other gun posts are on top of the fuselage and in the belly.

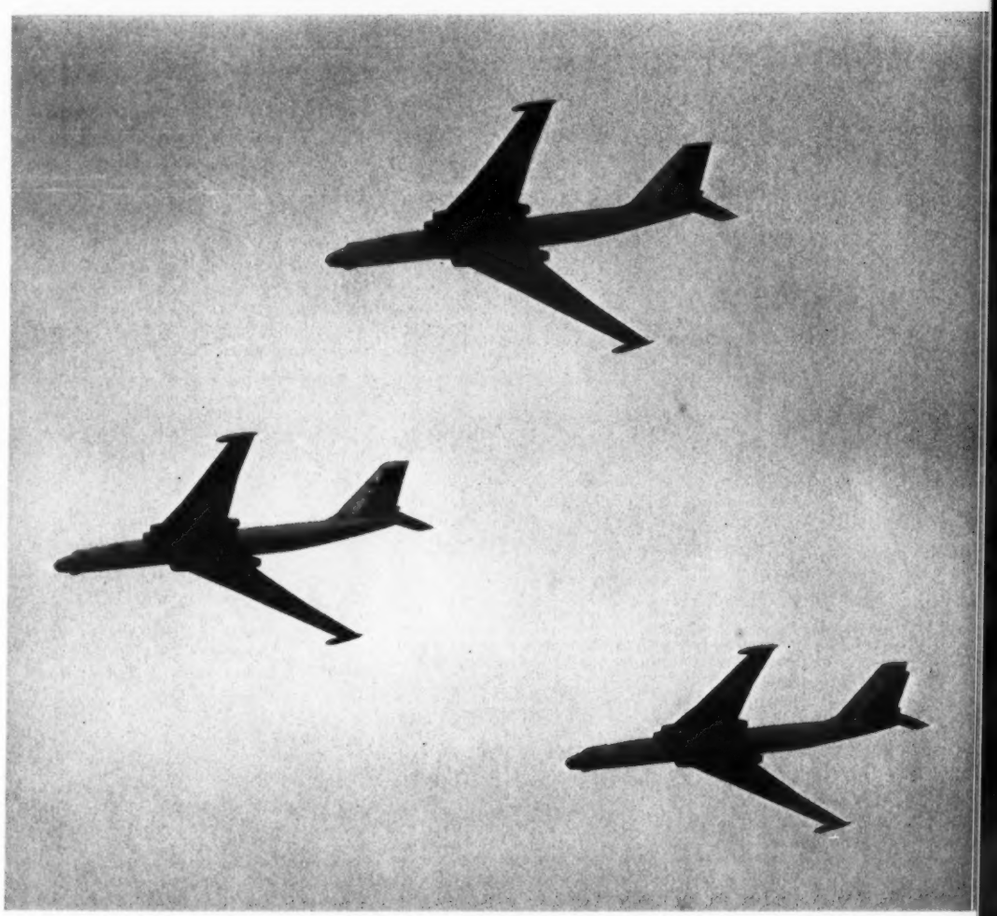
the left: Marshal S.Y. Rudenko (Chief of the Air Staff), Marshal S. M. Budyenny, Marshal V. D. Sokolovsky, Marshal S. S. Biryusov, Marshal R. Y. Malinovsky, Marshal K. S. Moskalenko, Marshal Y. S. Koniev, Marshal G. K. Zhukov (Defence Minister), Marshal P. F. Zhigarev (Commander-in-Chief of the Red Air Force), V. M. Molotov, G. M. Malenkov, First Party Secretary N. S. Khrushchov, Marshal N. A. Bulganin (Prime Minister, *centre*), Marshal K. E. Voroshilov, L. M. Kaganovitch, N. Y. Beliaiev, M. G. Pervukhin, A. I. Mikoyan, M. Z. Zaburov, L. I. Brezhnev, E. A. Furtseva, N. M. Shvernik, P. N. Pospelov. (The only absentee was thus Foreign Minister Shepilov, who was touring the Middle East.)—Left and right of the Government stand, on two broad, open terraces, were the 28 foreign military missions with their Russian companions, and the whole diplomatic corps accredited to Moscow.

At 10 a.m. sharp the display opened with a salute of twenty guns, while the Red Army band, in company strength, played the Soviet national anthem. Immediately, the first 19 aircraft (towing banners) appeared on the horizon.

Undeterred by the weather, the organizers stuck to their programme. Within 85 minutes a total of 376 aircraft and helicopters and 39 parachutists appeared over Tushino. Even the weather seemed impressed; the rain gradually stopped, and a little later the sun even came out.

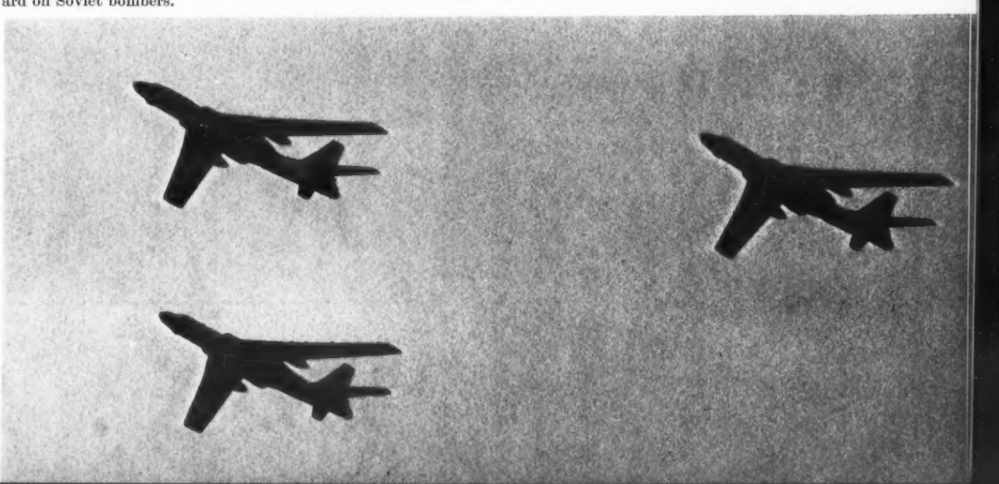
*

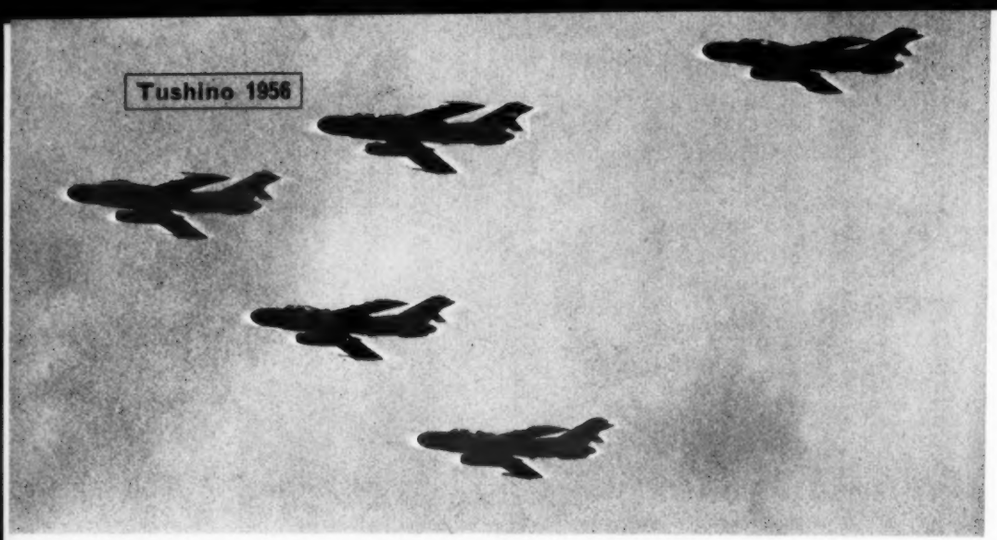
It would be monotonous to describe in full all twenty items on the programme. The reader will get a much better idea of them from the official programme reproduced below (the only editorial touches added are the type designations and the number of aircraft involved). The most striking overall feature was the high degree of precision in the formation flights and acrobatic programmes and the accurate timing of the various items.



Three Ilyushin *Bison* four-jet long-range bombers, also featuring radar bulge, rear gun post and additional fuselage defence posts. Drop-shaped fairings at the wing tips take the auxiliary wheels, while the tandem main undercarriage is retracted into the fuselage.

First Vee of nine Tupolev *Badger* twin-jet medium-range bombers. Radar bulge and rear gun post apparently are standard on Soviet bombers.





A total of fifty Yak-25 *Flashlight* twin-jet all-weather fighters (with large rounded radar nose) flew over the airfield. This aircraft is said to be armed with large-calibre cannon under the fuselage floor and to be fitted with powerful axial-compressor jets.

Programme of the Tushino Air Display June 24th, 1956

Overall command: Marshal P. Zhigarev, Commander-in-Chief of the Red Air Force.

Opening at 10 a.m.—Close at 11 : 25 a.m.

Part I: Demonstration by DOSAAF organization (Friends of the Army, Air Force and Navy) under the command of Lieutenant-General T. Kutsevalov.

1. Fly-past by 19 Yak-12s towing banners:
   — leader: flag of U.S.S.R.
   — two aircraft: "Slava Sovietskomu Narodu" (Glory to the Soviet People)
   — sixteen aircraft: flags of the 16 Soviet Republics.
2. Fly-past by 76 Yak-18 trainers in "letter" formation spelling the words "Slava KPSS" (Glory to the Communist Party of the Soviet Union).
3. Acrobatic demonstration by a glider.
4. Simultaneous winch launching of three Mak-15 swept-forward gliders to an altitude of 1,600 ft., followed by an acrobatic demonstration.
5. Aerobatics by seven Yak-18 trainers (160 h.p.) piloted by women (group leader Mrs. Bodriaguina).
6. Aerobatics by 21 Yak-18 trainers piloted by men (group leader Natsarov).

Part II: Air Force display, under the command of Colonel-General Z. Rubanov.

7. Acrobatic display by a jet fighter of undisclosed type (Major Lapshin).
8. Acrobatic display by a jet fighter of undisclosed type, with ejection of coloured smoke (Lieutenant-Colonel Pavlov).
9. Formation aerobatics by four jet fighters (apparently MiG-19 *Farmers*)[1] under the command of Colonel Soloviev.
10. Formation aerobatics by five jet fighters (apparently MiG-19 *Farmers*) under the command of Colonel Babaiev.
11. Aerial combat exercise by two formations of three jet fighters (MiG-17s or MiG-19s) under the command of Lieutenant-Colonels Fokin and Stetsenko.
12. Formation acrobatics by nine jet fighters (MiG-17s or MiG-19s) under the command of Colonel Shulienko.
13. Fly-past by 16 long and medium-range bombers in flights of three:
    — leaders (one *Bear* turboprop bomber and two MiG-17 fighters), under Colonel Kharitonov;
    — three *Bears*, under Colonel Verbitski;
    — three four-jet *Bisons*, under Colonel Pozhidaev;
    — nine twin-jet *Badgers* in Vee formation, under Major Protassov.
14. Fly-past by 50 twin-jet all-weather fighters (Yak-25 *Flashlights* with rounded radar nose), under Colonel Vovk, and 60 single-jet day fighters (MiG-19 *Farmers*), under Lieutenant-Colonel Stepanov (all aircraft in Vee formation of five).
15. Fly-past of two transport prototypes:
    — twin-turboprop assault transport by O. A. Antonov, armed with twin tail cannon;
    — Tu-104 twin-jet commercial transport by A. N. Tupolev.
16. Fly-past by new jet fighter prototypes by A. Z. Yakovlev (two developments of the Yak-25 *Flashlight*), A. I. Mikoyan (two developments of the MiG-19 *Farmer*) and O. P. Sukhoy (three delta-wing fighters).

Part III: Parachute jumps and airborne exercises by the Army, under Lieutenant-Generals N. Skripko and V. Margelov.

17. Controlled jumps by six soldiers from an Il-12 (under Lieutenant-Colonel Ovsiannikov).
18. Parachute jumps by three soldiers from an An-2 biplane, with change of parachute during descent (first square, then circular canopies) under Captain Antiukhin.
19. Mass jump by 30 paratroopers from five An-2 biplanes (under Captain Kramskoy).
20. Airborne operation by a mixed helicopter unit:
    — Fly-past by twelve formations of three Il-12s (simulating the occupation of an airfield by a mass airborne landing) under Colonel Polikanov;
    — Approach, landing and departure of four large twin-rotor helicopters (Yak-24 *Horse*) and 36 single-rotor helicopters (Mil-4 *Hound*) under Colonel Erofevski;
    — Unloading of 164 men, 22 cross-country vehicles, 12 anti-tank guns (57-mm) and 4 double-barrel anti-aircraft guns (20-mm) within five minutes under Lieutenant-Colonel Trofimenko.

[1] In the absence of Russian type names, N.A.T.O. designations are given: F (e. g. *Farmer*) for fighters; B (e. g. *Bear*) for bombers, H (e. g. *Hound*) for helicopters.

In keeping with the official policy of co-existence and arms limitation proclaimed by the Soviet Government for the past year, main stress in the display was clearly laid on weapons for *air defence:* 26 single-jet day fighters of MiG-17 and MiG-19 types, singly or in acrobatic formation; 50 Yak-25 twin-jet all-weather fighters (N.A.T.O. designation *Flashlight*)[2] and 60 MiG-19 (*Farmer*) day fighters in a high-speed fly-past in formations of five.— Although almost all are reputed to be supersonic, the low cloud layer kept their speeds below 600 m.p.h.

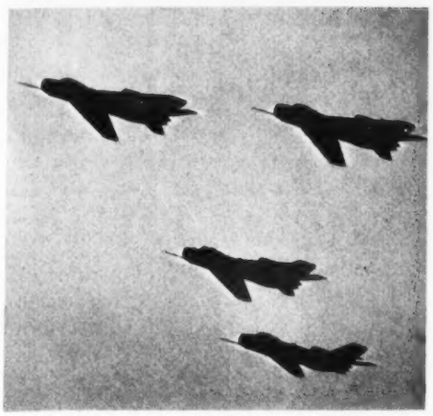
In contrast to this mass display of fighters *only sixteen bombers* were shown: four *Bear* long-range bombers and anti-submarine aircraft (designed by Tupolev) with four turboprops and contra-rotating propellers, three Ilyushin *Bison* long-range four-jet bombers, and nine Tupolev *Badger* medium-range twin-jet bombers in flights of three.[3]

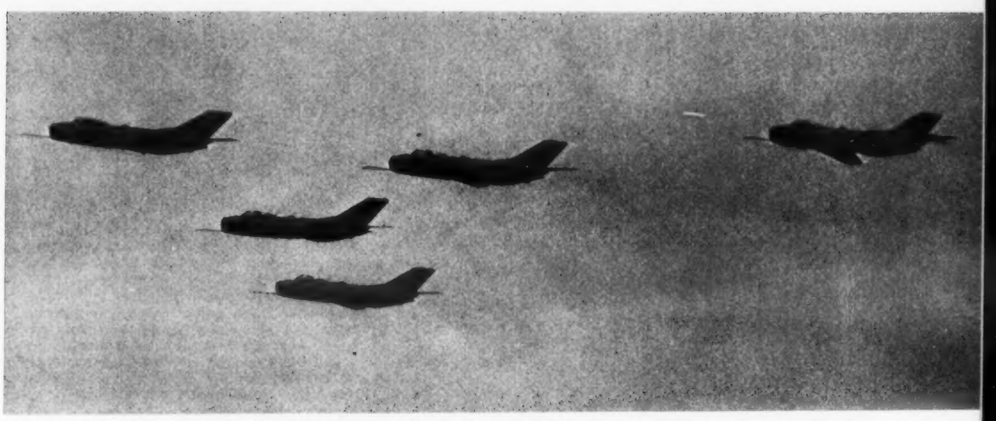
However, the "defensive note" was predominant only in the Air Force's ten items *(Part II)*. The Army's display *(Part III)* was

[2] In the absence of Russian type designations, N.A.T.O. code names are used here and in the following text. However, type designations *Yak-25* (for the *Flashlight* all-weather fighter designed by Yakovlev) and *MiG-19* (for the *Farmer* day fighter designed by Mikoyan) are now definitely established.

[3] During their visit to Kubinka air base (approx. 40 miles West of Moscow) on June 25th, foreign military delegations, who were driven in open cars past the parked aircraft, noted that the *Badger* can be equipped for in-flight refuelling. Another "hit" at Kubinka was the landing of a *Bison* long-range bomber with the aid of three brake parachutes, during which the undercarriage was clearly seen to consist of two four-wheel tandem bogies in the fuselage and two small auxiliary wheels at the wing tips.

Pointed-nose Yakovlev *Super Flashlight* all-weather fighter (agency picture).

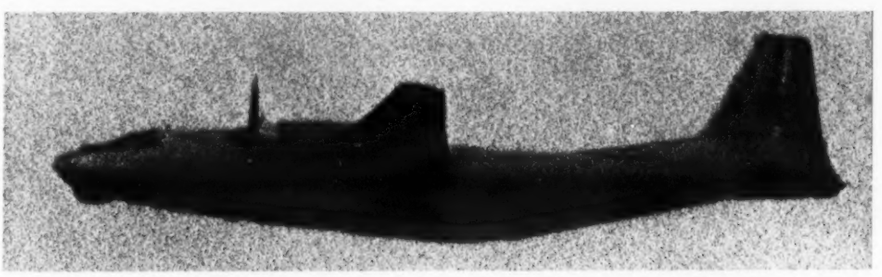




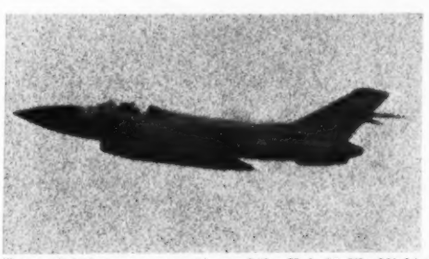
Day fighters followed night fighters in similar strength: MiG-19 *Farmers* (possibly supersonic), probably with powerful radial-flow engines (plus afterburners) and armed with one or two large-calibre cannon underneath the fuselage. They are also said to carry up to 32 unguided air-to-air rockets.

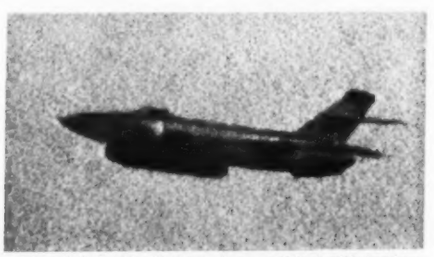
unmistakably of offensive nature: precision parachute jumps by 39 soldiers (from Il-12 twin-engined transports and An-2 biplanes), fly-past by 36 Il-12s which would have dropped a whole paratroop battalion had the weather been better or the ground wind less strong, and an airborne operation by 40 helicopters.

The last event was the most impressive of the whole show. Four Yak-24 *(Horse)* twin-rotor helicopters and 36 Mil-4 *(Hound)* single-rotor machines demonstrated how to occupy an airfield without warning within eight minutes of first appearing on the horizon. Admittedly, the field was undefended... But even in real military operations there might be little opposition after massive fighter-bomber attacks and mass paratroop descents. At any rate, the forty helicopters unloaded the following fully motorized units within a few minutes: five jeeps carrying a total of 34 men, twelve vehicles towing 57-mm anti-tank guns and crews totalling 96 men, four vehicles towing 20-mm anti-aircraft guns and crews totalling 32 men, plus a single jeep bringing up the rear. A Moscow Radio Commentator gave the total strength of the airborne unit as 175 men, but we ourselves counted only 164 (see above).—The helicopters approached, touched down, unloaded with rotors turning and took off again absolutely simultaneously and with the utmost precision.

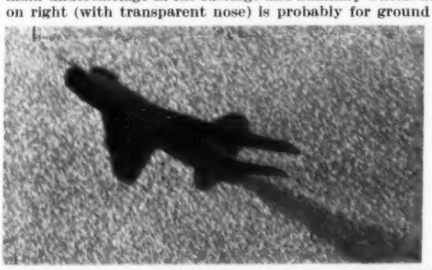


Twin-turboprop assault transport by O. A. Antonov, with the inevitable radar bulge and rear gun post. The undercarriage is retracted into bulges underneath the fuselage. — A civil version for medium-stage traffic is reported to be under development.





Two pointed-nose new versions of the Yak-25 *Flashlight* all-weather fighter, like their predecessor fitted with tandem main undercarriage in the fuselage and auxiliary wheels at the wing tips; axial-flow engines with afterburners. Version on right (with transparent nose) is probably for ground attack duties.

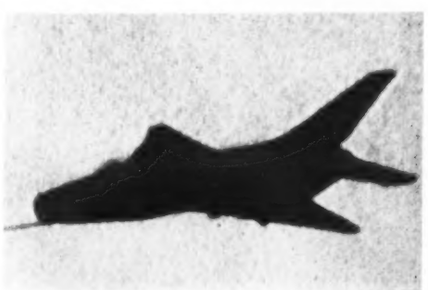


Development of the MiG-19 *Farmer* supersonic fighter with enlarged wing centre section and lower set tailplane (type designation MiG-21 ?).

What was new at Tushino?

First comment should be given to three, hitherto unknown, *delta-wing aircraft* by Russian

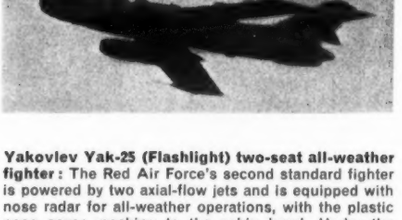
Sukhoy delta No. 1: it flew past so fast that no details could be recognized.



Sukhoy delta No. 2: low-set measuring boom; cut-off air intake with central shock diffusor; sharply swept tail unit; bulge under rear fuselage.

Sukhoy delta No. 3: high-set measuring boom; conical protuberance in front of the air intake; less sharply swept tail.

Mikoyan MiG-19 (Farmer) interceptor: This single-seat aircraft was first shown in large numbers at the 1955 Soviet Aviation Day parade and now forms, with the Yak-25, the backbone of Russia's home air defence force. It is armed with one or two large-calibre cannon and up to 32 unguided air-to-air rockets (in four containers under the wing) and seems to have been designed for the transonic range. External features: low-set tailplane, long "keel" under rear fuselage, sharply swept wing (leading edge sweep approx. 60°) with two large boundary layer fences (its MiG-17 predecessor has six smaller fences). An unusual point in a sonic fighter is the conventional aerial mast on top of the fuselage. A special feature is the flattened jet pipe which is evidently equipped with an adjustable narrowing device for its adaptation to the afterburner.



Yakovlev Yak-25 (Flashlight) two-seat all-weather fighter: The Red Air Force's second standard fighter is powered by two axial-flow jets and is equipped with nose radar for all-weather operations, with the plastic nose cover reaching to the cabin hood. Under the fuselage, roughly on a level with the cockpit, it carries two large-calibre cannon or—possibly—a rocket launcher in a flat pack. The two main undercarriage units are retracted into the fuselage (under the radar nose and under the wing), and the two auxiliary wheels into tear-drop fairings at the wing tips. The sharply swept wing (roughly 40°), as in most Soviet military aircraft, has boundary layer fences—two on each side. The fuselage is roomy enough to carry a substantial load of fuel.

Tupolev turboprop combat aircraft (Bear): In service in small numbers with the Red Air Force, this four-turboprop type is reportedly used primarily for anti-submarine warfare and possibly also as a tanker. The four propeller turbines (shaft power per engine probably approximately 10,000 h.p.) each drive two contra-rotating propellers; cruising speed probably approx. 450 m.p.h. The tear-drop extensions of the inboard engine nacelles take the main undercarriage units, which are retracted backwards. Fairing for the scanner of a search radar under the nose, manned gun posts on top of the fuselage (remote controlled from a sighting dome in the pressure cabin) and in the fuselage rear. A rotating turret under the fuselage rear, not shown in the accompanying silhouette, is remote-controlled by a third gunner, who sights through transparent domes on either side of the fuselage rear. — Comparison with the escorting MiG-17 suggests a span of approximately 180 ft. A civil version (designation Tu-114) is in development.

designer *Pavel Sukhoy*, which flew past at very high speeds and pulled up into a climb very sharply. During the latter manoeuvre, tail-plane flutter was noticed in one case.

In addition, two larger *developments of the MiG-19 (Farmer) supersonic day fighter* and two *new versions, with pointed nose (in one case transparent), of the Yak-25 (Flashlight) all-weather fighter* were shown.

Last but not least, the Soviet Union now has, in *Oleg A. Antonov's* twin-turboprop machine, an apparently efficient *assault transport* for about 30 fully-equipped troops.

*

The following types, though not demonstrated at Tushino, were lined up on the ground at Kubinka air force base (where photographers were banned):

- *a twin-jet swept-wing bomber*, approx. 70 ft. in span and allegedly supersonic;
- *a twin-jet armoured single-seat (Stormovik) ground attack aircraft*, about 50 ft. in span;
- *a single-engine three-seat anti-submarine aircraft* (span approx. 50 ft.), with turboprop, long shaft, contra-rotating propellers and transparent nose.

*

By 11:25 a.m. the Tushino show was over. Leningrad Chaussee again became a one-way street, this time in the other direction. The first to leave were, of course, the official ZIS's and ZIM's followed by the diplomatic cars. We waited a few minutes until the road was free for more ordinary mortals.

Conclusion. For us—two fortunate representatives of the West's aviation press—the "Iron Curtain" had been raised a little. For the first time it had been possible not only to see modern Russian military aircraft from fairly close quarters... but even to photograph them. Our pictures[4] are herewith submitted to our readers, who will be able to form their own impressions of Russian aeronautical developments. *At any rate there was no lack of up-to-date designs at Tushino.*

Tushino Comments

Several of the heads of foreign air force missions who attended the Tushino Air Display on June 24th as guests of the Soviet Government were asked for their impression of the show. While their replies were necessarily polite, they nevertheless confirm that the Display was a success despite the difficult conditions under which it was held.

General Nathan F. Twining, Chief of Staff, U.S. Air Force, in Moscow: "... The timing

[4] **Strictly copyright 1956 by *Interavia*, Geneva, Switzerland.**

and arrangements of the Display were excellent ... The Soviets have a good Air Force ... My trip was worthwhile ..." Back in Washington, General Twining told newspaper correspondents: "... Obviously I can't pose as an expert on the Soviet Union after a brief and very well controlled visit." He is also reported to have said that qualitatively the U.S. Air Force is superior to the Soviet Air Force, that provided the U.S.A. does not "fall asleep" and implements its aircraft production programme it will be "in good shape". The heads of the Soviet Air Force would probably be invited to the U.S.A. and their visit would be as strictly controlled as his own to the Soviet Union.

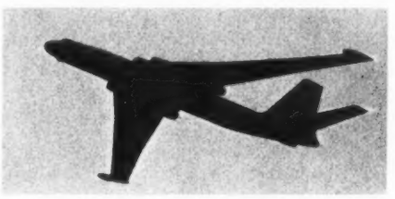
Air Chief Marshal Sir Ronald Ivelaw-Chapman, Vice-Chief of Air Staff, Royal Air Force: "... The display was a masterpiece of organization ... The flying and timing of the events was excellent ... A high standard of airmanship was displayed ... The experimental aircraft were certainly capable of very high speeds ..."

British Air Minister Nigel Birch told the House of Commons: "... The visits (to various Soviet Air Force facilities, factories, etc.) were in the nature of conducted tours. The restrictions placed upon us were not unreasonable ..." The British plan to invite a party of Russian officers and industrialists to the S.B.A.C. Display at Farnborough in September.

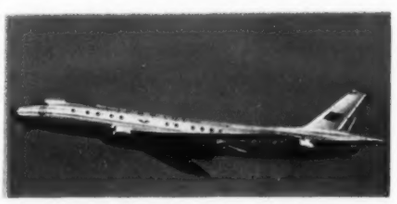
General Paul Bailly, Chief of Staff, French Air Force: "... The display was superb as regards general organization and programme ... Events followed each other with extreme accuracy ... disclosing excellent training of the fliers and a superb standard of handling jet aircraft ... It would be premature to speak of

On the visitors' stand at the V. P. Chkalov Central Aero Club, Tushino: Lieutenant-General Andrei Nicolaevitch Tupolev (with hat) in conversation with Dr. A. E. Russell, Chief Designer, Bristol Aircraft Company.

Tupolev twin-jet medium-range bomber (Badger): In squadron service for about the past three years, this type is still being produced in large numbers. It can be equipped for in-flight refuelling. In its dimensions (span approximately 115 ft.) and performance it is roughly comparable to the British V-bombers. The two extra powerful jets of about 17,500 lbs. thrust are mounted in the wing roots and may be equipped with afterburners. (The engine nacelles are slightly longer and thicker at the rear than in the Tu-104). The two main undercarriage units are retracted rearwards into separate nacelles on the wing trailing edge. Under the nose is a navigation and bombing radar. Defensive armament, unusually heavy by Western standards, comprises an unmanned tail post, a rotating turret underneath the rear fuselage (remote-controlled from a post with lateral "sighting bulges" near the tail) and a rotating turret on top of the fuselage (remote-controlled from a gun post with sighting dome behind the cockpit). Hence the crew must consist of five or six men.



Four-jet long-range bomber (Bison), probably designed by Ilyushin, with intercontinental range and a cruising speed in the region of Mach 0.9. Apparently fitted with the same engines as the Tupolev jet bomber, this type has been in production for at least two years. To judge from photographs, span is about 180 ft. and therefore approaches that of the eight-jet Boeing B-52. The two four-wheel bogies of the main undercarriage are retracted forwards and backwards respectively into the fuselage, the auxiliary wheels into tear-drop fairings at the wing tips. The *Bison* too has relatively powerful defensive armament: a manned tail post, a remote-controlled rotating turret on top of the fuselage (with sighting dome behind the cockpit), and another underneath the forward fuselage (with sighting domes on either side of the nose). Both *Bison* and *Badger* use brake parachutes to shorten the landing run and are said to require only a short take-off distance. A civil version of the *Bison* is planned (designation Il-18?).



Tupolev Tu-104 jet transport: Designed for cruising speeds of 500 to 560 m.p.h., this twin-jet transport was developed largely from the *Badger* bomber and can carry a payload of roughly 8 tons over a distance of more than 1,800 miles. Official Russian sources give the take-off run as 4,600 to 5,260 ft., so that with its wing loading of approx. 82 lbs./sq. ft. (take-off weight 75 tons) the aircraft can operate from medium-sized airports. — The Tu-104 was first shown at the 1955 Soviet Aviation Day parade and is "soon" to go into regular service on domestic Russian air routes and later on routes to the Eastern *bloc* countries. According to the Russian press, it is already in production. Span approx. 115 ft., length approx. 121 ft., aspect ratio approx. 6.5.

Four Yak-24 *Horse* twin-rotor helicopters, the leading formation of airborne units, approach the airfield . . .

. . . which had been "occupied" a few minutes previously by paratroops. Thirty-six Il-12 transports (some of them visible behind the parachutists) fly over the field to simulate further mass parachute jumps.

Finally the main unit, consisting of 36 single-rotor Mil-4s, lands in close formation. The helicopters are unloaded within a few minutes, with rotors turning . . .

. . . and on taking off in formation leave on the field 22 cross-country vehicles, twelve anti-tank guns, four double-barrel anti-aircraft guns and 164 troops.

Russian aircraft as a whole, but those we saw are perfect . . . Soviet aircraft are the product of high industrial technology . . ."

General V. Bubanj, Yugoslav Air Force: ". . . Since 1946 Soviet aviation has made a great stride forward . . . The Display was splendidly organized . . . The bad weather showed that Soviet pilots can fly with great skill even under severe meteorological conditions . . ."

Air Vice-Marshal Mohamed Sidki Mahmoud, Chief of Air Staff, Egyptian Air Force; ". . . What I saw surpassed all my expectations. The skill of the Soviet pilots can hardly be overestimated. . . The aeroplanes I saw were good, particularly the fighters . . ." (*Editor's* note: Air Vice-Marshal Sidki also told *Interavia* that the Egyptian Air Force is "delighted" with the MiG-15 fighters and Ilyushin Il-28 light jet bombers it has received under the well-known arms deal of last year. Whether they are built in Czechoslovakia or in Russia, he said, the MiG-15's are absolutely identical. The remarkable simplicity and ease of maintenance of the Russian aircraft, as compared with earlier equipment operated by the Egyptian Air Force *(Vampires* and *Meteors),* was especially attractive to a young service like the Egyptian Air Force.)

Lieutenant-Colonel Rashed Kelany, Syrian Air Force: ". . . The group piloting of supersonic production jet fighters was top class . . . The programme ticked like a precision clock . . ."

Air Commodore D. Singh, Indian Air Force: ". . . The display at Tushino? Excellent! Soviet aviation? Superb!"

Marshal of the Soviet Union G. K. Zhukov, Defence Minister, is reported by "Time" magazine to have told U.S.A.F. General Twining that "the U.S.A. overrates Russian power—perhaps to justify bigger and bigger military budgets . . ."

Marshal Zhukov Receives

Marshal Zhukov's guests listen to their host's speech. In background is the yellow and blue flag of the Soviet Air Force.

With a precision and timing resembling that of the air demonstration at Tushino in the morning of June 24th, 1956, car after big black car slid up to the entrance of the Soviet Central Army Club in Moscow in the afternoon of the same day. Marshal of the Soviet Union G. K. Zhukov, Soviet Defence Minister, was giving a reception to the members of the twenty-eight foreign air force missions who had descended upon Moscow for the annual Soviet Aviation Day. The guests, all of whom arrived in the company of their Soviet Air Force cicerones and interpreters, were quickly ushered into the vast park of the Club, where rows of banqueting tables had been set up.

Minutes after the last of the cars had deposited its load and rolled away to the parking area, a torrential cloudburst drove hosts and guests into the spacious lounges and drawing rooms of the sprawling club building, curiously watched by the kitchen help peering out of the basement windows. The rain had one beneficial effect: the stiff atmosphere prevailing at the beginning of the reception dissolved into a mood of informality, and representatives of air forces from all over the world mingled freely with the Soviet big shots, including top brass such as Premier Bulganin, Party Secretary N. Khrushchov, Messrs. Mikoyan, Malenkov, Molotov, and so on.

The inivitation was typically Russian-style. Although it started at four o'clock in the afternoon, preparations had been made for a huge banquet, with long tables bending under loads of caviar, smoked salmon, fried chicken, meat, the inevitable cucumber salad with sour cream, various meats, dozens of varieties of pâté, oranges, bananas, apples and apricots, bottles of Soviet champagne, vodka, sherry, cognac, Caucasian and Crimean red and white wines and mineral water. About an hour after the guests had been driven inside by the rain, a procession formed in one end of the building as Marshal Zhukov, Marshal Bulganin, Mr. Khrushchov and others led the foreign guests to a large hall where the banquet had been reorganized beyond the influence of the Moscow weather.

Marshal Zhukov at the head table delivered a brief address and toasted the friendship of the peoples (see Box). His toast was the signal for brief applause, after which everybody concentrated on the tables.

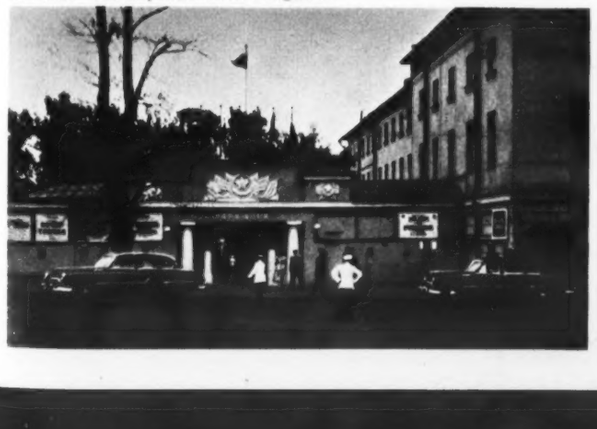
By six o'clock the weather had cleared, and groups of hosts and guests gradually drifted into the grounds again. Marshal Bulganin assumed a role which now seems to be becoming a tradition at Soviet receptions of this kind and took British Air Minister Nigel Birch for a row-boat ride on the lake. Marshal Zhukov, the official host, paid especially marked attention to General Nathan F. Twining, U.S.A.F. Chief of Staff, in front of a pavillion at the end of the lake. Senior air force officers of various nations stood on one of the small landing stages holding fishing rods and lines which had been baited for them by an old employee (nobody caught anything). Groups of officers wandered along the paths, meeting other groups and being introduced to them, eating ice-cream, whipped cream and strawberries handed to them from trays. Background music to the idyll was provided by a military band lodged in a pavillion well away from the guests so that only muted chords of Viennese waltzes floated across the peaceful scene...

As Interavia's *two Special Correspondents were leaving the Central Army Club, the party was still going on at full blast. In one small coppice a new table had been laid, surrounded by two dozen chairs, and a parting glance revealed American generals and Soviet leaders toasting each other...*

The chiefs of the foreign air delegations in Moscow

Afghanistan	Colonel Abdul Rezak
Albania	Major-General Kito Chaco
Bulgaria	Lieutenant-General Zakharien Zakhariev
Burma	Major-General T. Clift, Officer Commanding the Burmese Air Force
China	Colonel-General Lu Yalu, Commander-in-Chief of the Chinese Air Force
Czechoslovakia	Lieutenant-General I. Vassaglo
Denmark	Lieutenant-General Tage Andersen, Chief of the Danish Air Force
Egypt	Air Vice-Marshal Mohamed Sidki Mahmoud, Chief of Staff, Egyptian Air Force
Finland	Major-General Artola
France	General Paul Bailly, Chief of Air Staff
Germany (East)	Major-General Heinz Zorn
Great Britain	Air Minister Nigel Birch; Air Chief Marshal Sir Ronald Ivelaw-Chapman, Vice-Chief of Air Staff; as well as an industrial mission
Hungary	Major-General Ferenc Madarasz
India	Air Commodore D. Singh
Indonesia	Air Vice-Marshal S. Suryadarma, Chief of Air Staff and O.C., Indonesian Air Force
Iran	(not available)
Korea (North)	Lieutenant-General Van Len
Mongolia	Lieutenant-Colonel Togochi-in Samdan
Norway	General Birger Motzfeldt, Chief of Air Staff
Poland	Major-General Kadatsanovitch
Rumania	Lieutenant-General Lopecky
Sweden	Major-General Folke Ramström
Switzerland	Colonel-Divisionnaire (Major-General) Etienne Primault, Chief of Staff of Swiss Air Force
Syria	Lieutenant-General Rached Kelany
Turkey	General Fevsi Ucaner, Chief of Air Staff
U.S.A.	General Nathan F. Twining, Chief of Staff, U.S.A.F.
Viet Nam (North)	Major-General Van Tien Dung
Yemen	Crown Prince Emir Saif Al-Islam Mohamed Al-Bader (not as head of a delegation but on a State visit in Moscow)
Yugoslavia	Colonel-General V. Bubanj

Arrival of the Delegations at the Soviet Army Central Club in Moscow. *Left to right:* Entrance to the club. – The U.S.A.F. Delegation, surrounded by U.S. journalists, arrives at the club. – The Royal Air Force Delegation.



Marshal G. K. Zhukov's Address

Marshal G. K. Zhukov.

During the reception he gave to the twenty-eight foreign missions to the 1956 Soviet Aviation Day on June 24th, Marshal G. K. Zhukov, Soviet Defence Minister, addressed his guests in the following terms:

"...I want to thank the participants in the air parade and our aircraft designers, engineers, workers and employees of the aircraft industry.

This year representatives of 28 states are present at our air celebration and I express the wish to see them also in the future as our guests.

Such meetings pave the way for the development of contacts between military and political leaders. Experience has shown that personal contacts are the most effective means of establishing mutual understanding and that they help to ease international tension and to create greater confidence between states.

Indisputable progress in reducing international tension has been made in recent years. This progress could have been greater if all states, and in the first place the Governments of the Great Powers, had displayed full readiness to reduce their armed forces, including mass destruction weapons, and thus had saved mankind from the fear for its future.

The Soviet Government is consistently pursuing a policy of peace and is working for a solution of the disarmament problem.

It seems to me that I will express the opinion of the majority of the large number of military men present if I say that the military, too, must live in the interests of the people and direct their efforts towards putting an end to the arms drive which is a heavy burden for the people, for a country's budget. We military men must reckon with the fact that in our days the rate of development of armaments and technical means of warfare is incredibly rapid. Weapons and other material of today will prove obsolete tomorrow and the people's money spent for their manufacture will be wasted. I think that military leaders cannot but take an interest in the living conditions of their people and must actively promote a solution of the disarmament problem, the establishment of lasting peace among the nations, and full confidence between the states.

I raise my glass to our guests, the participants of the air parade, all present here, and toast the friendship of the peoples!"

Lieutenant-General E. M. Beletsky.

Aeroflot's Activities

An outline of the activities and plans of Aeroflot, the Soviet civil airline, was given to *Interavia*'s two Special Correspondents in Moscow in an interview at the end of June by Lieutenant-General E. M. Beletsky, Deputy Director-General of the line, and Colonel V. M. Danilychev, Manager of International Operations.

Equipment problems: Aeroflot now has "hundreds" of Ilyushin Il-12 and Il-14 transports in service on its 200,000-km route network (without local and Arctic services), and delivery of Il-14s by the industry is continuing at a rapid rate (production was reported in Moscow to amount to about 30 to 50 aircraft a month). The General said he did not recall the exact number of such aircraft now in operation with his line.

As regards jet operations, the General said Aeroflot has been operating Ilyushin Il-20 aircraft, a civil version of the Il-28 light jet bomber, for several years in the transport of mail, newspaper mats, etc., but not with passengers. Purpose of the operation is to gather wide experience in preparation of full-scale jet air services. A "certain number" of Tupolev Tu-104 twin-jets has been delivered to the line; the aircraft have been in regular mail and cargo transport operations since the beginning of this year. Within two months the Tu-104 will be introduced in domestic passenger service and a "certain time" after that it will go on to the international passenger routes. Another modern transport aircraft, a four-engined turboprop design by Tupolev for 170—180 passengers (reportedly designated Tu-114) will be delivered to Aeroflot very shortly. The prototype is now in the "final stages of adjustment".

Other sources in Moscow reported that Tupolev is also engaged in the design of a pure-jet transport capable of flying non-stop from Moscow to New York. In addition, Ilyushin is said to be working on a medium-range four-jet design for 75 passengers.

General Beletsky said his organization was not concerned with efforts to export the Tupolev Tu-104 jet abroad but would obviously help such efforts if the opportunity arose.

Navigation aids: Aeroflot's aircraft are equipped with ILS, General Beletsky said, and are therefore able to use any airport in Western Europe (in contradiction, American radio-navigation experts say that the Russian ILS works on the phase modulation principle, whereas all western ILS-equipment is based on amplitude modulation -Ed.-).

Crew training: Aeroflot has not experienced any shortage of pilots because the line's operating capacity is planned several years ahead and the requisite number of crews is trained accordingly. Pilot candidates join Aeroflot at the age of 19 and are given two years of flying training. After that they spend two years on Aeroflot's local services, in agricultural and aerial survey work and then return to the major routes as co-pilots. At the age of 35 they are eligible for retirement at a monthly pension of 1,500 rubles, which rises with longer periods of service. A co-pilot's average monthly pay is 4,000 rubles.

International relations: Asked whether the Soviet Union is considering joining the International Civil Aviation Organization, General Beletsky said the question was not topical at the moment. Nor did Aeroflot plan to become a member of the International Air Transport Association in the immediate future. However, Aeroflot was studying the statutes and articles of association of both organizations as well as the potential advantages it might derive from joining them. Even without being a member of either of the two organizations, Aeroflot finds no difficulty in operating to 22 foreign countries. The IATA Clearing House in London is not considered a necessity, since payments can be arranged under the commercial treaties the Soviet Union has with numerous countries.

Aeroflot's Director-General, Marshal Zhavoronkov, will go to London shortly to discuss an extension of the existing Anglo-Soviet commercial treaty to make possible the inauguration of direct air services between Moscow and London.

Plans for direct services between the Soviet Union and the U.S.A. are not urgent, and such services depend upon Soviet-U.S. relations. Aeroflot expects a delegation from Pan American Airways in Moscow in the near future and hopes to establish a working agreement with the American company on the basis of reciprocity.

Aeroflot has now withdrawn from all the mixed airline companies which were established after the war in countries of the Communist bloc.

Left to right: The British industrial mission. – The French Air Force Delegation. – Record flier Madame Jacqueline Auriol with the French Delegation. – The Swiss Air Force Delegation.

Ex-Foreign Minister Molotov; Minister Kaganovich; Power Stations Minister Malenkov.

Soviet dignitaries and foreign guests at banqueting table. *Left to right:* Marshal Zhukov (standing), Party Secretary N. S. Khrushchov; interpreter; General Nathan F. Twining, U.S.A.F.; interpreter; Crown Prince of Yemen.

Just coming in out of the rain are Air Chief Marshal Sir Ronald Ivelaw-Chapman, R.A.F. Vice-Chief of Air Staff; Party Secretary Khrushchov; Marshal Zhukov; British Air Minister Nigel Birch.

Soviet First Vice-Premier Anastas Ivanovich Mikoyan; interpreter; Air Vice-Marshal Mohamed Sidki Mahmoud, Chief of Staff, Egyptian Air Force.

The head of the Swedish Delegation, General Ramström; interpreter; French Chief of Air Staff General Paul Bailly; V. J. Molotov.

Party Secretary Khrushchov, Marshal Zhukov, General Twining, Soviet Marshal Sokolovsky.

Left to right: Polish Air Force Mission in foreground, Chinese Mission waiting in background. – The Egyptian Air Force Mission. – Crown Prince of Yemen arrives.

Pentagon

The U.S. Forces Fight it Out

BY INTERAVIA STUDY GROUP

"I spend half my time fighting against the encroachments of the other two services," said an Air Force general at the Pentagon recently. "One of the problems in German rearmament," says a Staff officer in Bonn, "is whether the air arm is to be run by the Air Force or the Army." "There can be no armed services without a powerful Navy, and the new theories that a general war would be so short that the navy would not be required are pure imagination," says a Royal Navy officer. "It is the Air Force, not the Army, who should operate the artillery observation aircraft, the light combat air units, helicopters and assault transports," stated a French general in connection with recent orders for aircraft for the land forces overseas. "Anti-aircraft missiles? They are our affair, since they are an extension of the artillery," says the army. "Who is responsible for air defence," retorts the air force, "the army or the air force?" "You want atomic bomb vehicles to be invulnerable to attack on the ground. What better solution is there than the aircraft carrier with its constant mobility?" says the U.S. Navy. "The aircraft carrier invulnerable? You make us laugh," replies the U.S. Air Force. "Everybody knows that any reasonable radar can pick up your floating base from 200 miles away. And in any case the carrier can operate only bombers of limited range."

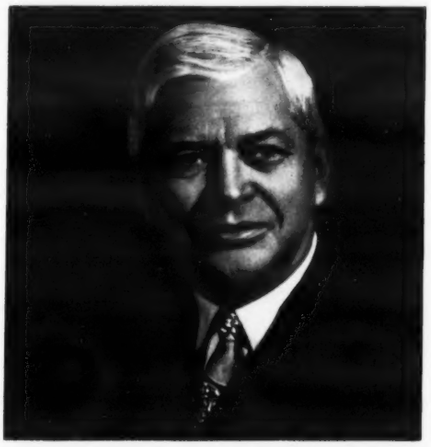
Although apparently in agreement, the United States Army and Air Force are divided on the basic concept on which a possible future world war would be fought, explained a U.S. Army staff document issued during the height of the budget debates.

Thus the inter-service dispute now extends to all countries, though it takes on its sharpest features in the United States because of the tremendous sums involved. Doubtless even the Kremlin has similar problems.

*

The reasons are at least three-fold.

1) A brief eleven years after the end of World War II the West finds that despite its superior atomic armament it has lost 700 million people who have passed behind the Iron Curtain. "U.S. News and World Report" for May 25th, 1956, drew up the dismal balance sheet of a period marked initially by the Anglo-Saxon atomic monopoly and later by their obvious superiority not only in the matter of bombs but also in number and quality of the aircraft capable of launching them. The military, led by the Pentagon, are asking what are the reasons for this setback—though these reasons are more political than military. But the result is that each service accuses the others of inflexibility or of excessive expenditure on useless or inefficient weapons.



Charles E. Wilson, Secretary of Defense.

2) The Kremlin's campaign of smiles may dissolve the bonds of fear which unite the Western nations in a purely defensive alliance. Each member country thus seeks to spend less on collective security and more on its own economy or its own special military problems. And each of the three services tries to retain at least the same share of appropriations as was awarded it during the previous period. Estimates for the three departments are gone over with a fine tooth comb, with the critics this time being not the economists but the military themselves.

3) But the dominant reason for the inter-service dispute is the technical development in weapons themselves.

Many weapons are being specialized to an increasing extent. No sooner had the engineers succeeded in building transports capable of taking off from grass runways close to the fighting line than the army claimed them for their use. Tomorrow they will be demanding new dive bombers designed to extend the

Wilbur M. Brucker, Secretary of the Army.

Charles S. Thomas, Secretary of the Navy.

Donald A. Quarles, Secretary of the Air Force.

Admiral Arleigh A. Burke, Chief of Naval Operations.

Admiral Arthur W. Radford, Chairman of Joint Chiefs of Staff.

General Nathan F. Twining, Chief of Staff, U.S. Air Force.

now inadequate range of their artillery and hence of little use for other purposes. Specialized aircraft have enabled navies to build up air arms. What is to prevent armies from demanding other specialized aircraft to supplement their ground equipment?

The missile era is approaching. The transition from the conventional to the new weapons is already taking place. None of the three services is anxious to compromise its future by ceding to another even part of the terrain in which the missile will hold sway. Hanson W. Baldwin, military correspondent to the "New York Times" explains the situation thus: the art of war has been and will continue to be so profoundly modified by electronics, atomics and the combination of aircraft and missile that no clear dividing line can be drawn between armies, navies and air forces, or between tactics and strategy; today it would be a brave man who would define in terms of weapons the exact meaning of air, land and sea power.

Finally, the atomic weapon upsets every basic concept. If, as the U.S. Air Force—led by General LeMay—maintains, the extent of damage inflicted by a fleet of A-bombers were so great that a few hours, or at most a few weeks, would suffice not only to decide the outcome of any general war but also to neutralize vast areas, then the role of military forces, such as navies, which cannot intervene instantly, would be greatly reduced. The admirals naturally do not subscribe to this theory, which is also rejected by General Maxwell D. Taylor, who considers that such a brutal and murderous form of warfare is unlikely. The U.S. Air Force's young colonels retort that the problem is not to rescue the classic art of war by preserving combat on a more or less humane level, but firstly to prevent war by the threat of massive retaliation and, secondly, if this threat proved insufficient to prevent an outbreak of hostilities, to survive it by deluging the enemy with A and H bombs. As will be seen later, this is truly a dialogue between two stone deaf; both arguments are valid; indeed they are mutually complementary.

*

The United States as test bed for inter-service disputes

The famous B-36 versus aircraft carrier battle is too well known to need discussion here. What began as an argument around basic principles degenerated into a battle of personalities, the repercussions of which have persisted until recent months. Eight years ago the Air Force suffered not only a frontal assault from the Navy, but also a lateral attack by the Army, which won from it the right to full control over the air resources "necessary for the proper execution of its missions".

The 1947 National Security Act, amended in 1949, lays down in substance that the Army should have all the combat and support units it needs to conduct its operations on land, as well as such air equipment and naval transport as are indispensable to these operations. An Army-Air Force agreement signed in 1951 by Frank Pace Jr. for the Army and Thomas K. Finletter for the Air Force defined in detail the part to be played by Army aviation and expounded in general terms the Armed Forces Act.

Under this agreement the air strength needed by the Army may include all aircraft used by this service inside the combat zone[1] and forming an integral part of the ground forces... The Army's air missions should not, however, overlap those the Air Force performs in direct support of ground fighting, for assault transport, aerial photography, tactical reconnaissance or bombing of enemy ground troops and communications.

The air groups attached directly to the Army should consist of light fixed-wing aircraft and helicopters specially designed for the following missions:

air observation;
reconnaissance of ground situations;
communications within the combat zone;
laying of aerial cables in the combat zone;
transport of supplies for small ground units inside the combat zone, although large-scale supplies for the Army fall within the Air Force's competency.

This agreement was to extend considerably the role played by the Army's air groups. Air units were attached to all Army units down to battalion level and to each of the seven subdivisions (artillery, infantry, armoured corps, communications, ordnance, engineers, supplies).

Though now only five years old and never applied in full, the Pace-Finletter agreement is already out of date. The Key West agreements (1948), signed under the auspices of the then Secretary of Defense James Forrestal, have also been invalidated by the addition of new weapons to the Pentagon's arsenal. Even

[1] It was understood that the combat zone would not normally exceed 50 to 80 miles in depth.

in 1948, however, the three Chiefs of Staff were each struggling to obtain the lion's share of the post-war armed forces budgets. The bitterness of the dispute is illustrated by the fact that at Key West the Chiefs of Staff specified that all words used in the text of the agreement were to be interpreted according to the meaning given them in the complete edition of Webster's international dictionary.

When the Key West agreement was signed, the Army possessed 200 aircraft. Today it has roughly 4,000 and Lieutenant General James M. Gavin, head of Research and Development on the U.S. Army Staff, insists that even if the Army had 20,000 aircraft of all types, these would barely meet its requirements.

So fundamental a revision of the results obtained at Key West is worrying the Air Force. During the last meeting of the Service chiefs in Bermuda, Brigadier General Robert L. Scott, of the U.S. Air Force's Office of Information Service, said in substance that air power would henceforth be the supreme weapon and that even the most modern of land forces were out of date. All the airmen applauded—except one: General Norstad, future Supreme Commander, Allied Powers, Europe, fully aware of his responsibilities as inter-Allied and inter-service chief, protested against such a monopoly stating that it did not seem to him to be the moment to revive an old quarrel. But it was too late. To General Scott's document entitled "A Decade of Security through Global Air Power," U.S. Army General Metheny retorted by circulating a paper entitled "A Decade of Insecurity through Global Air Power".

In order to get public support against the Air Force, the Army sent its pamphlet to the "New York Times." What it demanded was a complete reorganization of the American defence system. The repercussions spread in widening circles. Testifying before a Senate subcommittee, Army Lieutenant General J. M. Gavin gave it as his opinion that a thermo-nuclear war would cost hundreds of millions of lives. If the wind should change over Western Europe, the results would be unthinkable, he added. Whereupon Senator Henry M. Jackson, a member of the subcommittee, announced that he was deeply shocked by what the Defense Department had publicly revealed, not so much from security considerations but from the point of view of the effect such statements would have on America's friends. — As will be seen, the whole of the United States' strategy is under fire.

The difference in outlook between the Air Force and the Army, its No. 1 opponent, goes very deep. What is at stake, however, is not only the basic concept of war. The Army accuses the Air Force of seeking control over all guided missiles in order to retain its place as an essential arm when piloted aircraft will have disappeared from the arsenal. Behind the dispute over the *Nike* and *Talos* anti-aircraft missiles lies the question as to who shall operate the medium-range and intercontinental ballistic missiles.

The Key West agreements made the U.S. Air Force responsible for the air defence of the United States, but entrusted the task of anti-aircraft defence to the Army. As long as the latter task was performed by artillery the agreements were not contested. But the advent of *Nike* batteries already caused the Air Force some concern, since the new weapons operate in a portion of the air space which it had always considered to be its special province. When the longer-range *Nike B* appeared and there was talk of installing the Missile Master system for the *Nike* batteries, the Air Force protested. The Air Force's Semi-Automatic Ground Environment (S.A.G.E.) system was a counterpart to Missile Master, and there were loud cries about duplication of effort. Pursuing a policy as old as diplomacy itself, the Air Force championed the Navy's *Talos* missile against the Army's *Nike,* allying itself briefly with its enemy of yesterday. And General LeMay, Commander-in-Chief of Strategic Air Command, stated that he would rather have his bases protected by *Talos* than by *Nike.*

Again under the Key West agreements, the U.S. Air Force was made responsible for strategic missions and hence for the operation of intercontinental missiles, initially as a supplement to manned bombers and later possibly as their replacement. Convair is already working on the *Atlas* and Glenn L. Martin on the *Titan.* But the *Army,* allying itself now with the Navy, is developing the *Jupiter* intermediate range missile (1,300 to 1,500 miles), in the hope that this range can eventually be made intercontinental and thus break the Air Force's monopoly. Meanwhile the Air Force is also interested in the *Thor* (range 1,500 miles), which is a rival to the *Jupiter.* Thus each service is encroaching on the other, as is inevitable. No-one can prevent a missile that is promising in one field from being developed to the point where it overlaps into another.

*

The Air Force—Navy dispute revived

As far as the public is concerned, this time it is the U.S. Air Force that has attacked first. Testifying to the Senate subcommittee on May 11th, General Twining said: "The targets that can be attacked by such carrier-based planes as are available also depend upon the location of the carriers at the time . . . The range of the carrier aircraft is relatively short compared with that of their land-based counterparts. But we must be realistic about the probable location of the carriers as well as the amount of striking power that they can contribute to the strategic air offensive—which is small." Five days later Admiral Arleigh A. Burke, Chief of Naval Operations, answered by explaining that the strategy of the Navy's air groups is to attack any enemy forces capable of intervening in naval operations. But, he added, they can also

General Maxwell D. Taylor, Chief of Staff, U.S. Army.

General Randolph McC. Pate, Commandant of the U.S. Marine Corps.

The Inter-Service Dispute — Some of the Causes

Concept and organization

— The Army contests the validity of the Air Force's contention that the combination of B-52 long-range bombers and H-bombs renders conventional ground forces practically useless.

— The Army complains of the small interest the U.S.A.F. shows in airborne troops.

— The Army has 280-mm atomic gun batteries. The Air Force and Navy contest their value.

— The Army, which now operates 4,000 light aircraft, states that it really needs 20,000. The Air Force is concerned at such ambitions.

— The Navy is convinced of the efficiency of the ten super carriers it has ordered.

— The Air Force can see no utility in these carriers and argues that its own aircraft are more efficient.

Aircraft

— The Army is reportedly sponsoring development of a transport for a 3 to 5 ton payload.

— The Air Force would prefer to stick to the 1952 agreement which limited the empty weight of Army aircraft to 5,000 lbs.

— The Army wishes to free itself of arbitrary limitations.

— The Army demands long-range aircraft to test and follow its long-range missiles.

— The Air Force believes it should be responsible for these aircraft.

—Designers are working on VTOL aircraft for the Army.

— The Air Force, which has similar projects, protests against overlapping.

Guided Missiles

— The Army is hanging on to its *Nike A* and *B* guided missiles and their fire control equipment.

— The Air Force is asking for *Talos* missiles and the unification of the fire control system and S.A.G.E.

— The Army is developing the *Redstone* surface-to-surface missile (range 200 miles). The Air Force thinks this missile would operate in what is now its province.

— The Army and Navy are working jointly on an intermediate range missile, the *Jupiter*. Its range (1,500 miles) covers the Air Force's operating zone and approaches that of the intercontinental missile.

— The Navy and Air Force are developing similar (air-to-air) missiles.

be used within the framework of a joint effort directed against other targets which might cause difficulties for the United States forces.

As always in such situations, once the heads had opened the battle, they were quickly followed by their juniors, who provided the American press with some very interesting information:

1) The Navy's most up-to-date carrier aircraft has a range of less than 1,500 nautical miles. The aircraft carriers responsible for placing them within range of important targets in Soviet-controlled territories would have to penetrate inland seas or cruise in coastal waters. They would then be highly vulnerable to attack by enemy land-based aircraft.

2) The radar equipment necessary for the defence of these vessels can also be used to guide enemy aircraft towards the fleet. And, the Air Force slyly adds, two B-36s could comb the whole of the North Atlantic from Greenland to the Tropic of Cancer in 24 hours. An aircraft carrier could be detected 200 miles away and located with an error of less than 11 nautical miles.

3) A radar operator in a reconnaissance aircraft flying at medium altitude can scan an area of almost 15,000 square miles in 20 seconds. And three B-36s could "rake over" some 1,500,000 square miles, or an area roughly equivalent to the Mediterranean, in three hours.

4) If the Russians should decide to destroy the United States' aeronuclear means of retaliation, they would need thirty times as many projectiles for the U.S. Air Force's land bases as for the Navy's floating airfields.

5) Seventeen aircraft carriers house 1,120 fighters for the sole purpose of defending themselves, or a quarter as many fighters as are detailed for the defence of United States territory.

6) Aircraft carriers of the *Forrestal* class cost roughly $ 200,000,000, without counting the aircraft embarked in them. If the full programme for ten heavy carriers is completed the total cost will thus be in the region of $ 2,000,000,000, again not counting the cost of some thousand aircraft at roughly one million dollars.

7) Land air bases are admittedly vulnerable, but the Navy also need land bases to support their carriers, and these are no less vulnerable than S.A.C.'s bases.

The dispute continues, each service attacking the other two. Even the President has had to intervene, and Defense Secretary Charles E. Wilson has not been spared accusations of all kinds.

*

One uniform for all services?

The dispute in the Pentagon has gone to such lengths that President Eisenhower ordered an enquiry, early in June 1956, into the possibility of unifying the three armed forces. Proposals of all kinds have since been worked out and submitted to the White House.

The last service reform in the United States was made shortly after World War II. Until the end of the latter there was no independent Air Force, but only the Army Air Forces and the naval air service. Since then the U.S. Air Force, though the youngest service, has developed by leaps and bounds, becoming today the strongest and most favoured of all three. It is scarcely surprising that the other two should be jealous of this growth, which has been possible only at their expense, through cuts in their shares of budget appropriations.

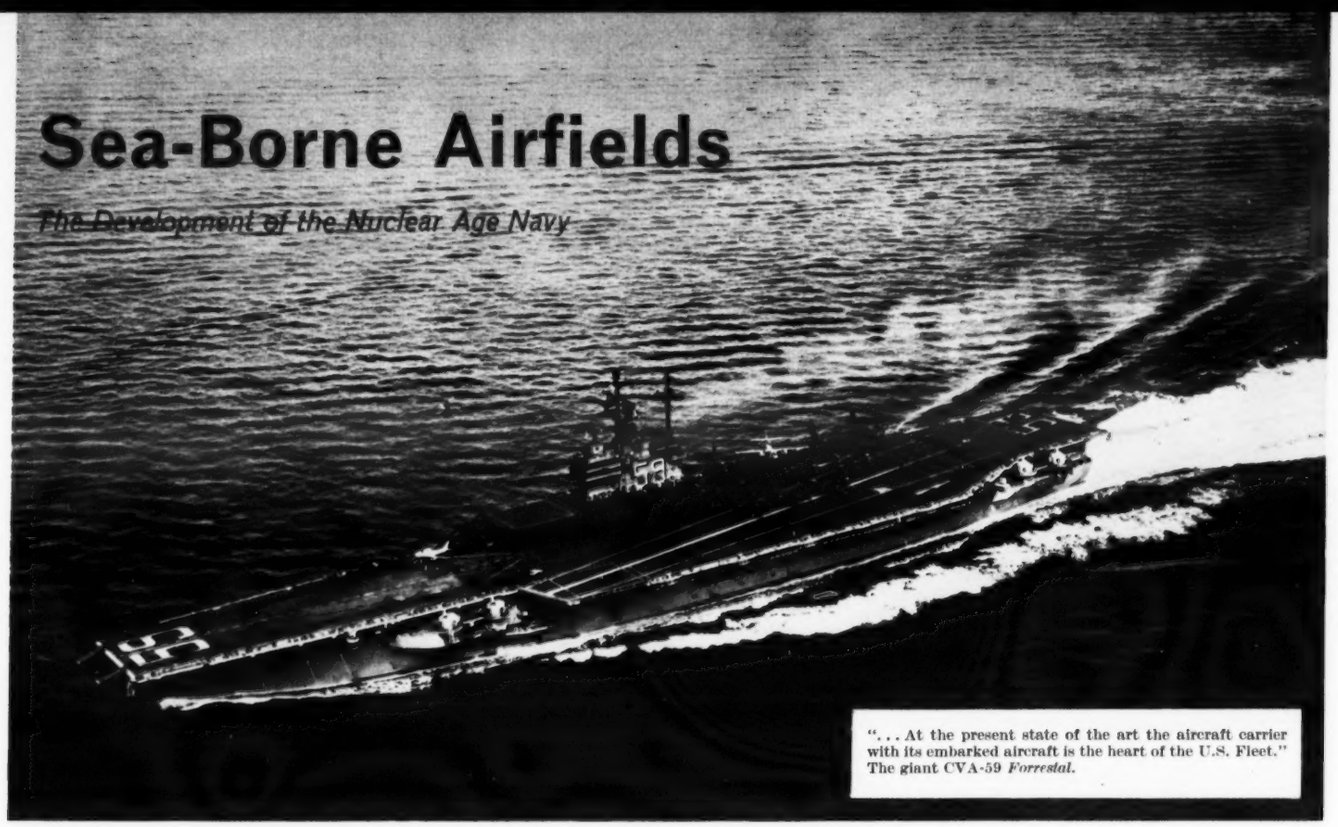
The last reorganization was made, however, at a moment when, with the Axis powers defeated, it was thought that a long period of peaceful development lay ahead. The Korean war was to shatter this illusion.

It is no easy matter to unify three such powerful organizations as the Army, Navy and Air Force are today. To carry through such a measure under present international tension might even appear hazardous, not only for the United States but also for the whole of the Western world, whose strongest shield is U.S. military strength. The desire for reform undoubtedly originated with the Army and the Navy, but—through the irony of fate—necessarily gives rise to a situation in which reorganization can be effected only under the protection of General LeMay's Strategic Air Command, which such reorganization would deprive of its autonomy.

But this Rubicon has not yet been crossed. The decision will probably not rest with the military, but rather with the White House.

Sea-Borne Airfields

The Development of the Nuclear Age Navy



"... At the present state of the art the aircraft carrier with its embarked aircraft is the heart of the U.S. Fleet." The giant CVA-59 *Forrestal*.

BY JAMES H. SMITH, JR.,
ASSISTANT SECRETARY OF THE NAVY (AIR), WASHINGTON

A graduate of Harvard College and of Columbia University Law School, Secretary Smith was designated a naval aviator in 1932. During World War II he served as a pilot in scouting and torpedo squadrons flying off the Yorktown *and* Belleau Wood *and later served on carrier divisional and task group staffs in the Pacific. A vice-president of Pan American World Airways (1946—1949) and Director of Slick Airways (1949—1953), he was appointed Assistant Secretary of the Navy for Air in July, 1953. Secretary Smith submitted his resignation from his Washington post at the end of May, but while President Eisenhower has already nominated a successor in the person of Garrison Norton, he is expected to remain in office still for some time.*

The rapid technological progress which we are now experiencing is having a dramatic impact upon Naval weapons and Naval thinking. The guided missile cruiser and the nuclear-powered submarine, combined with the modern carrier, make up a team of mobile sea-borne launching platforms suitable for unmanned as well as manned weapons.

However, at the present state of the art and for some time to come the aircraft carrier with its embarked aircraft is the heart of the U.S. Fleet.

Evolution of Carriers and Aircraft

From the beginning the aircraft carrier has demonstrated its ability to handle the most modern aircraft. This has been the result of constant evolutionary improvement of basic components, that is, the catapult, the arresting gear, the elevators, and the servicing provisions, rather than by quantum increases in the size of the carrier. During the same period it has been necessary to extend, widen and strengthen runways ashore manyfold and, unfortunately, the end is not in sight.

Since 1930, carrier fighter and attack aircraft landing and launching speeds have increased approximately 2½ times, while the aircraft weights have increased almost 10 times. At the same time, airfield runway lengths have been extended by a factor of more than 5 to absorb this growth in aircraft. On the other hand, the length of the flight deck of the attack carrier has increased only about one-

Some world records held by U. S. Navy

Date	Altitude/Speed	Type Aircraft	Flight Crew
Altitude			
June 7, 1923	14,193 feet	Davis-Douglas	Lt. C. F. Harper
May 5, 1927	33,455 feet	Apache	Lt. C. C. Champion
June 4, 1930	43,166 feet	Apache	Lt. Apollo Soucek
Maximum Speed over 3 Kilometer Course			
November 4, 1923	266.58 mph	Curtiss R-2C-1	Lt. A. J. Williams
August 25,1947	650,796 mph	D-558-1	Major Marion Carl, USMC
October 3, 1953	752.943 mph	F4D	Lcdr. J. B. Verdin
Maximum speed over 100 Kilometer Course			
October 16, 1953	728.114 mph	XF4D	Bob Rahm, Douglas Aircraft Test Pilot
Maximum Speed over 500 Kilometer Closed Course			
October 15, 1955	695.127 mph	A4D	Lt. Gordon Gray

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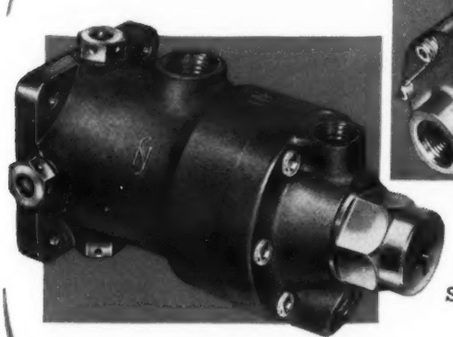

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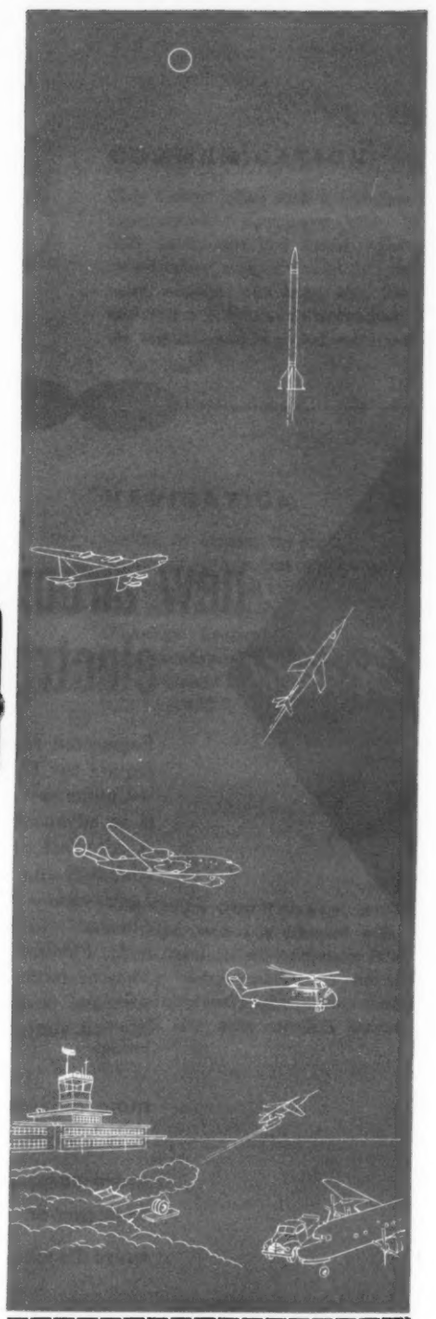

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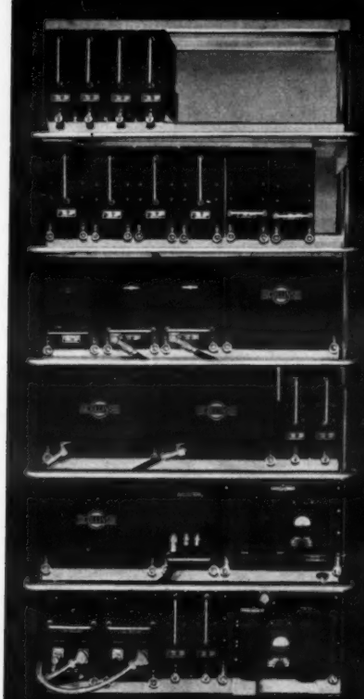
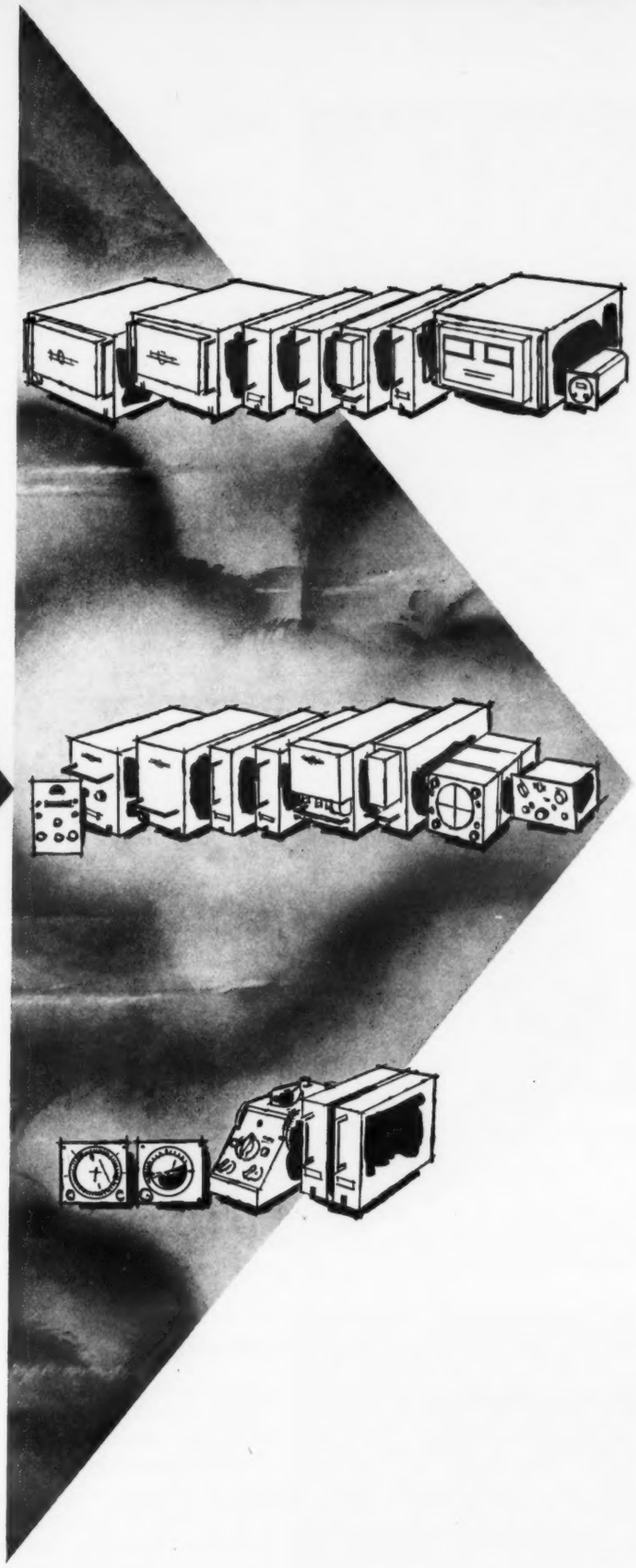


Top Shelf: Dual Integrated Flight System; 2nd shelf: dual VHF Xmtrs and Rcvrs, dual Selcal; 3rd shelf: Automatic Pilot, dual VOR/LOC Rcvrs, SSB HF Rcvrs; 4th shelf: dual SSB HF Xmtr, dual Glideslope Rcvrs; 5th shelf: second SSB HF Rcvr, ATC Beacon Transponder, Radar Synchronizer; Bottom shelf: dual ADF, Interphone Amplifier, Marker Rcvr, and R/T of Radar.



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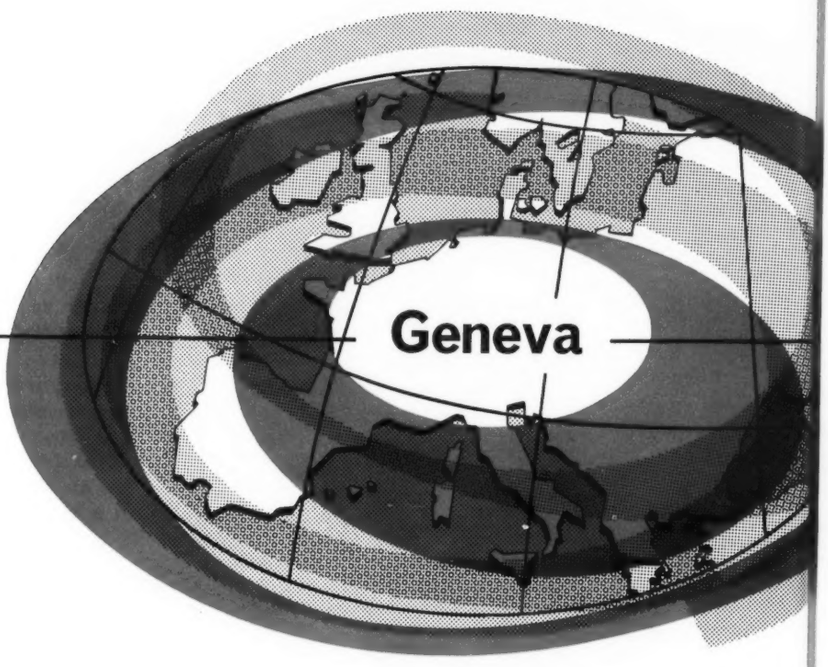

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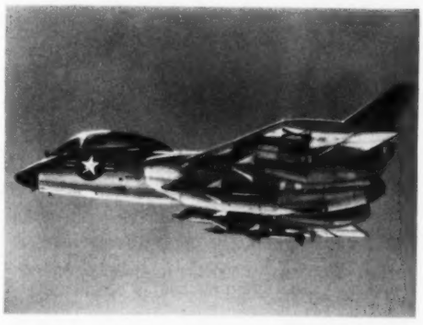
third. This can be seen by comparing the *Forrestal* with the *Ranger,* the first carrier designed as such from the keel up.

How has it been possible to accommodate the tremendous growth of aircraft without building aircraft carriers today that are five times as long as those of 1930? First, it is true that there was a large margin to accommodate increased aircraft speed and weight inherent in the design of our early carriers due to the relatively large landing and take-off areas provided. Second, to accommodate the increase in landing speed, improved energy-absorbing devices have been developed. The capacity of the arresting gear has been increased about tenfold, and efficient safety barriers have been developed, although with the advent of the angled deck they are no longer required, except in an emergency resulting from a broken or malfunctioning hook on the landing aircraft. Third, as higher take-off speeds have required longer take-off distances ashore, these have been provided aboard the carriers by improved catapults. The energy-output capability has been increased some 33-fold in the past 20 years. Further, where 400 to 600 feet were required to free-launch World War II fighters and attack aircraft, through use of the catapult that was cut to less than a hundred feet. Free-launch of the latest Navy jet attack aircraft would require 4,000 to 6,000 feet, while the steam catapult launches these aircraft in about 200.

The Navy has not been forced to limit the performance of its aircraft due to restrictions imposed by the carrier. These aircraft have been topnotch, as evidenced by their holding many world's records in the past 25 years.

Typical deck scene on USS *Forrestal.*



The Chance Vought F7U-3M *Cutlass* carrier-based fighter armed with underwing Sperry *Sparrow I* air-to-air guided missile system.

New Carrier Inventions

We have also taken advantage of innovations which made truly sizeable improvements in carrier operations, and we are grateful to the British for their inventive contributions (see also later in this issue. -Ed.-).

A very significant new concept is the angled deck, which has been achieved by rotating the axis of the carrier's landing area 8-10 degrees from the fore-and-aft axis of the ship. Many advantages accrue. For example, the landing aircraft are not aligned with the aircraft which are parked or taking off, and if the pilot fails to engage an arresting wire he has ample room to take off and go around for another attempt.

As mentioned earlier, catapults have gone through a constant process of improvement in order to provide the higher and higher take-off speeds required by successive generations of fighter and attack aircraft.

The C-11 catapult, the U.S. service version of the British-designed steam catapult, has a capacity about 4.2 times that of the H-8, the latest U.S. hydraulic catapult. These steam catapults are being installed in the improved *Essex* and the improved *Midway* classes of carriers and in the waist of two ships of the *Forrestal* class. The C-7 catapult, which is the larger version of the C-11 catapult, has six times the power of the largest hydraulic catapult and is scheduled for installation in the bow of the *Forrestal* class. In fact, the C-7 catapult will launch all current carrier aircraft under zero, or even downwind, conditions.

A third British innovation is the mirror landing system. This device replaces the Landing Signal Officer, and allows the pilot to receive landing signals through a system of colored lights reflected from a four-by-five foot mirror. Results to date indicate that the increase in efficiency and safety of operation may be of the same magnitude as that resulting from the use of the angled deck and the steam catapult.

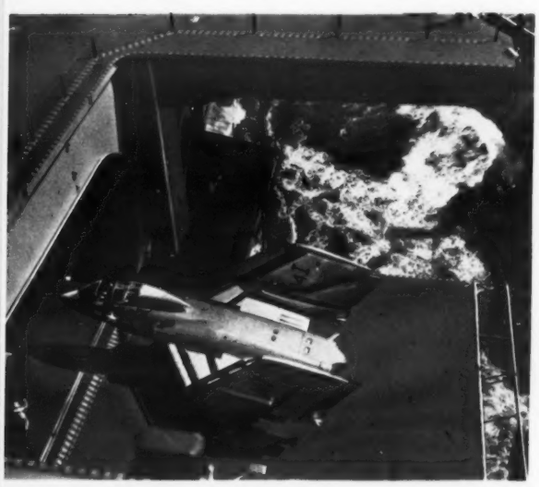
U.S. Navy jet fighters. Top to bottom: Douglas A3D *Skywarrior,* McDonnell F3H-2N *Demon,* Douglas F4D *Skyray,* North American FJ4 *Fury,* Grumman F11F-1 *Tiger* and Douglas A4D-1 *Skyhawk.*

Above, left: A Grumman *Tiger*, one of the U.S. Navy's new jet fighters, on the elevator ready for descent to the hangar deck.

Above, right: North American FJ-3 *Fury* jet fighters line up for take-off from the *Forrestal*.

Another new fighter, the Chance Vought F8U *Crusader*, being prepared for catapult launching.

A *Cutlass* is brought up on the deck edge elevator.



In addition to the major features mentioned above, the *Forrestal* and her sister ships incorporate less spectacular but important components all aimed toward the increase in flexibility and the reduction in "turn around time" between strikes. Electrical outlets for starting jets and additional facilities for servicing and testing new electronic equipment have been installed. Larger and better equipped workshops and aircraft control facilities are included. Moving stairways connect ready rooms with the flight deck to get the pilots with heavy flight gear to their planes in minimum time. Greater habitability for all members of the crew has been provided.

The effective operation of carrier based jet aircraft involves a complexity of factors such as aircraft weight, catapult capacity, arresting gear capacity, wind direction and velocity, carrier course and speed, task force course and speed, aircraft range and speed, fuel load, ammunition load, loiter time, landing interval, refueling time, re-arming time, spotting and launching interval, and so on. Each factor must be exploited to the maximum. When the design engineers have done their utmost, and their newest equipment is installed, there remains the final exercise of judgement based upon experience by the operating forces.

Importance of Atomic Power

The attack carrier with its steam catapults, angled flight deck and mirror landing system, provides a powerful sea-borne weapon system with inherent mobility and flexibility. It will remain the heart of our task forces for some time to come. But the Navy is not fixed on any one weapons system. It is our intent to remain flexible in our long range thinking as well as in our operations at sea. This is evidenced by the fact that our extensive research and defense efforts during the past ten years have produced other effective and revolutionary weapons systems. These systems, some of which are described in detail elsewhere in this issue, include the nuclear-powered submarine, the guided missile cruiser, the jet-propelled seaplane, the assault helicopter and anti-submarine and early warning aircraft.

For the Navy, undoubtedly, the most significant development of recent years has been that of nuclear propulsion which has a natural compatibility with the sea. This near approach to perpetual motion provides the Navy with mobility unlimited. The success of the *Nautilus*, the first true submarine whose natural habitat is beneath the sea, has been spectacular. *Seawolf* and several more A-subs are shortly to follow. Preparations are underway for the early construction of a missile cruiser and the design and procurement of a nuclear power plant for an aircraft carrier. The increased cruising range for ships, combined with a higher sustained speed and unlimited maneuverability, greatly expands the combatant scope of the all-nuclear Fleet.

The development of high performance aircraft, complemented by both air breathing and ballistic missiles, with which to arm its nuclear powered launching platforms, will provide the Navy with the capability to operate on the sea, under the sea and over the sea without complete dependence on the earth's atmosphere.

In discussions relative to sea-based power, particularly of a technical nature, reference is often made to the difficulties imposed by mounting large and complex weapons of today on floating bases. The Navy recognizes these problems. We gladly accept the engineering difficulties encountered in order to gain the tremendous advantages inherent in sea-going weapons systems.

Widely dispersed but mutually supporting and closely integrated, these weapons systems, now led by the attack carrier and her aircraft, comprise the logical development of sea-air-missile power in the atomic age.

The Development of Deck Landing Aids Since World War II

BY COMMANDER K. A. B. MACDONALD, D. I. C., ROYAL NAVY, LONDON

The Angled Deck

Birth of the Idea

In 1948 the appalling figures of the deck landing accident rate first came to my notice. In the Royal Navy there was a crash on deck once in every 63 landings, and by far the greatest number of these were barrier engagements. This was not only a vast drain on money, on naval resources, but also a drain on man-power, as the fatal accident rate was also high.

I was fortunate at that time to go to Royal Aircraft Establishment at Farnborough to witness the landings on the rubber mat. This struck me as the answer to the Navy's prayer for aircraft equal to or better than shore based aircraft, as design calculations had shown that the loss of the necessarily heavy naval undercarriage could save 8,000 lbs. on a 28,000 lb. aircraft! I anticipated however that considerable difficulty would arise when it came to flying the aircraft on to the single arrester wire (made necessary by the need to avoid damaging the belly of the aircraft) when the ship was pitching and rolling heavily. This was subsequently shown to be so, during the sea trials in H.M.S. *Warrior*.

The idea of angling the deck came to me as a result of searching for an answer to these problems. Having reached the angled stage I decided to go the whole hog and make the deck anglable, as 40° of angling gave, for example, 100° of tactical freedom on either side of a 10 knot wind. An imagined plan view of the deck mounted in H.M.S. *Illustrious* is shown in the accompanying illustration. It will be noticed that the angling idea enabled two decks to be fitted, without compromising the ability to carry a deck park or use the catapult while landing was in progress.

It is interesting in retrospect to recall how difficult it was to get many people to accept that it was possible to land on such a deck at all. They could not get away from the idea that the carrier seemed to be moving away from the flight path of the aircraft, and expressed the opinion that the pilot would have to "aim off", presumably like a man shooting a flying duck. Failing to convince them by vectorial analysis I put it this way. "Imagine the deck is as long as the flight path of the aircraft. Then if the wind relative to the deck lies directly down its centre line, an aircraft can fly, at any speed, directly down this line without being displaced sideways."

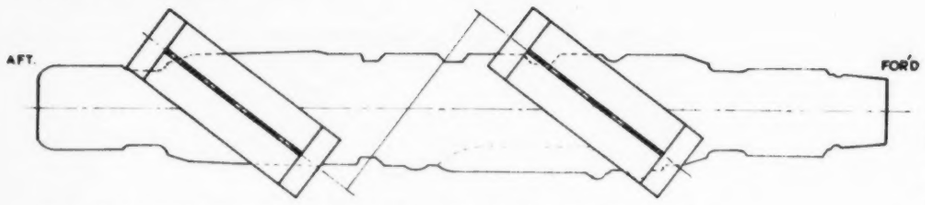
The above system of decklanding was still being discussed in the Admiralty and the Ministry of Supply when the barrier problem for high speed jet aircraft became so acute that, even if they could be stopped by the nylon net barrier, they were generally damaged beyond repair. As a direct result of this situation Captain D. R. F. Cambell suggested the angling of the rubber deck to eliminate the barrier, and Mr. L. Boddington, of the Ministry of Supply, suggested the angling of the ordinary deck for the same reason.

The loss of the barrier had other beneficial effects. Whereas the barrier and barrier pull-out area had previously been useless for anything else, it could now be used as a deck park, for increased pull out of arrester wires, or for catapults.

Experiment and Introduction

Once the principle of angling had been accepted, experiments to prove its practicability were pushed ahead with all speed. In February 1952 an angled deck was painted on H.M.S. *Triumph* to try out approach techniques. It was not of course possible to arrest the aircraft as the wires had not been angled, but sufficient touch and go landings were carried out to indicate that no major difficulties might be expected. The U.S. Navy seized upon this idea at once,

H. M. S. *Ark Royal's* angled deck. The aircraft landing is a Vickers-Supermarine N.113.



The author's proposal for two landing decks, angled at 40°, aboard H. M. S. *Illustrious*.

and very quickly converted the U.S.S. *Antietam* to a full angled deck carrier. They were able to carry out some thousands of deck landings without incident.

Unfortunately the construction of Royal Navy carriers did not lend itself to such drastic treatment, but a compromise was reached which enabled us to take advantage of the new system. This was the interim angled deck, which was angled at 5½° to the centre line, and was introduced in H.M.S. *Centaur, Albion, Bulwark* and *Eagle*.

Needless to say all future carriers at present envisaged will be fitted with the angled deck (8°—10°), and accident returns have fully justified its introduction.

The Mirror Sight

Inception

There is a charming and romantic story that the first "desk" trial of the mirror landing sight was carried out with the aid of a secretary's mirror and lipstick. As she succeeded in landing her dainty chin undamaged on the desk edge, experiments were immediately put in hand at R.A.E. Farnborough to produce a more practical if less attractive device. Many attempts had previously been made to produce a practicable deck landing sight, as it was realised that with the advent of high approach speeds the additive effects of the pilot's and batman's reaction times were becoming dangerous. The U.S. Navy had experimented with sector lights, but until Commander H.C.N. Goodhart, R.N., conceived his brilliantly simple device, nothing had been really satisfactory.

The present layout of the mirror sight consists of two concave aluminium mirrors one on either side of the ship, about ⅓ of the ship's length from the stern (where the vertical movement due to pitch is least). The mirror is about 4 ft. high and 5 ft. wide and is fitted with two arms of green *datum* lights. About 200 ft. abaft the mirrors are fitted light sources consisting of several horizontally mounted lamps. The mirror is inclined slightly to the vertical and is stabilised in that position. The pilot sees a blob of light, and if he keeps it in the centre of the mirror it will bring him down at a constant angle of descent of about 3°. The concavity of the mirror enables the pilot to pick up the light at about 45° to the straight approach path.

Advantages of the Mirror Sight

There are many advantages of the mirror sight, of which the following are but a few.

a) Human reaction time and error are halved.

b) The automatic quality of this system has drastically reduced the scatter on rates of descent, which should enable the strength and hence the weight, of naval undercarriages to be reduced.

c) It requires less pilot skill.

d) The motion and cliff edge effect of the ship are much less disconcerting.

e) The night deck landing problem has been made much simpler.

The mirror is now a standard fitting in all Royal Navy carriers, and at most naval air stations.

In the search for methods of improving naval aircraft performance experimental landings were made on an inflated rubber mat. Object here was to eliminate the heavy naval undercarriage.

No-Cut Technique

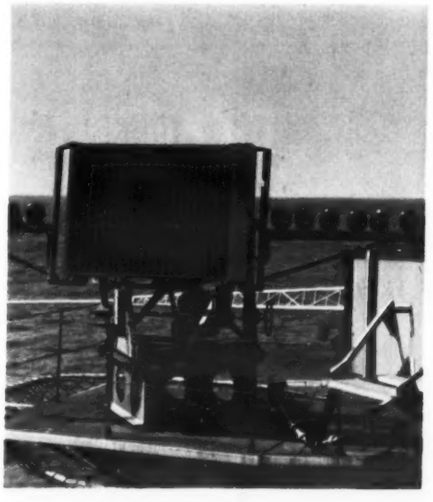
The desirability of the no-cut technique first came to the fore during the flexible deck landing trials. Here, as a straight and level approach was used, on to a single wire, it was natural not to cut the engine until the aircraft had been arrested, thus enabling a perfectly safe get away to be carried out if the aircraft missed the wire. With the introduction of the angled deck and hence the elimination of the barriers, it became a natural technique to use since, if the aircraft failed to pick up a wire, it was forced to take off and go round again. If engine power was kept on, this naturally became much simpler and safer.

Approach Speed Indication

This has always been a problem, due to the fact that allowable entry speed into the arrester wires is limited, and the pilot being thus restricted to a very small margin of speed above the stall, has still to keep his eye fairly firmly on the batsman or mirror.

Various attempts have been made to solve this problem, but the final answer has not yet been found. Work is now proceeding on the Audio Airspeed system, it being considered that the pilot has quite enough to *look* at, anyhow, and it would be as well to make use of one of his other senses. This was conceived, developed and test flown by Surgeon Commander W. H. B. Ellis, working at R.A.E. Farnborough and has so far been shown completely successful and reliable, both on ground and air tests. It is a simple device in which a change of note or "pips" indicate when the pilot is in his

British design for a mirror landing sight (shutters closed) with its two arms of green datum lights.



Supermarine N.113 with arrester hook in position for a deck landing.

Steam catapult in operation in H. M. S. *Ark Royal.*

correct airspeed range, and should enable him to concentrate his eyes entirely on the mirror and the deck.

Steam Catapult

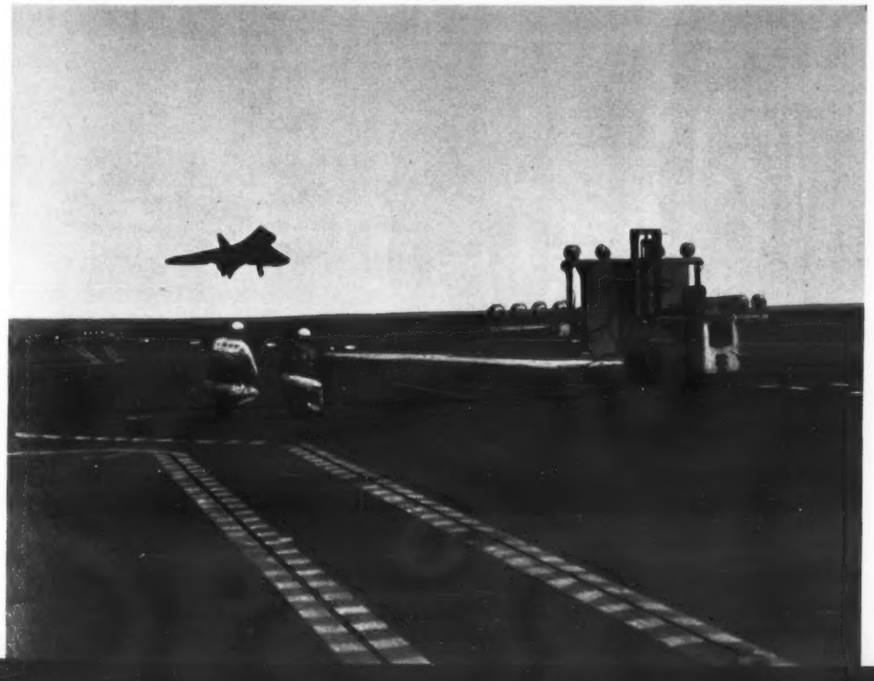
Though it is one of the most important carrier developments, the steam catapult has been left to last, because it is less obviously connected with deck landing than any of the other aids. It will be seen to fall within the subject matter of this article, however, when it is considered that the catapults obviate the use of the whole deck for take off, and so enable deck landings to be carried out while take offs are in progress. Besides, what comes down must first go up, and with present take off speeds, the steam catapult is the only economical method of achieving this desirable end.

Development of the British Steam Catapult

The German success in using the slotted cylinder catapult with cordite or hydrogen peroxide as propellant for their V.1 weapons, and the growing inadequacy of the hydro-pneumatic catapult, led to contracts being issued to Messrs. Brown Bros. of Edinburgh for a steam catapult, in 1946. Fortunately Mr. Mitchell headed the design team, and it was primarily his work which overcame the many difficulties encountered. He decided to use a steel sealing strip which was held on its seat by internal steam pressure, but the high internal pressure caused the cylinder to open at the slot, in spite of heavy external bracing. To avoid this problem, he introduced the revolutionary configuration in which the sealing strip became a structural member, in that it took the side loads trying to open the cylinder. This was highly effective, as an unbraced cylinder could be used, and the side loads on the strip added to its sealing qualities. Retardation was effected by an arm on the front of the driving piston entering a semi-openended cylinder, kept full of water by tangential jets. Decelerations of 180 G (as compared with 14 G for the BH. 5) were obtained, and quite acceptable.

The first Royal Navy carrier to be fitted with the steam catapult was H.M.S. *Ark Royal,* and results to date have been very satisfactory. There is no doubt whatsoever that the steam catapult can meet any weight and speed requirements that the Royal Navy will ever require of it.

The mirror sight has also been adopted by the U.S. Navy. Picture shows a mirror landing aboard the U.S.S. *Forrestal.* When the row of lights abaft the mirror is reflected as a single blob of light in the centre of the mirror, the pilot knows he is descending at a constant angle of 3°.



Conclusion

With the above devices in operation no difficulty is envisaged in operating any aircraft that may be designed until V.T.O. aircraft or guided weapons take over the defence and striking power of the fleet. Further advances in automatic landing aids are required to enable completely blind landings to be carried out, and the present semi automatic method of approach should enable a radar sight to be developed. Ideally such a system would be connected into the auto-pilot system to give complete automaticity. When such a system is developed the need for cruisers and other heavy purpose vessels should be virtually eliminated as carrier borne atom bombers will be able to deal with any enemy surface force. (Published by permission of the British Admiralty).

Naval Aviation in 1956

Preparing for 1960

BY VICE-ADMIRAL P. BARJOT

Vice-Amiral d'Escadre Pierre Barjot, as Commander of the French Naval Squadron in 1955 – 56, has taken part in most of the Allied exercises of recent years in the Mediterranean, the Atlantic and the Indian Ocean. In 1949 – 50, then a Rear Admiral, he commanded the French aircraft carrier group and the carrier-based air units. He has written numerous articles on naval aviation and aircraft carriers and last year published a book entitled "Vers la marine à l'âge atomique" (Towards the Atomic Age Navy). – Editors.

During the past few years naval aviation has experienced an upsurge that would not have been suspected possible ten years ago. After much controversy the aircraft carrier has won the day.

The past ten years

Developments between 1946 and 1956 in the United States, where the controversy reached its maximum intensity,[1] fall into the following phases:

1946—49:

Period of disfavour for naval aviation, coinciding with the advent of the intercontinental bomber. On April 23rd, 1949 Defense Secretary Louis A. Johnson cancelled the contract for the 60,000-ton aircraft carrier *United States*, the keel of which had been laid only a few days previously. Fifteen large carriers of the *Essex* class were "mothballed". The number of the U.S. Navy's air groups was drastically slashed. This led to the "revolt of the admirals" and to the dismissal of Admiral Denfeld as Chief of Naval Operations. President Truman appointed a commission of inquiry headed by Representative Vinson, which met in October 1949. Its report, published in April 1950, was not conclusive.

1950—51:

The Korean war, breaking out unexpectedly, revealed the value of the aircraft carrier in providing air support for land operations. Carrier-based jet aircraft, in particular the F9F *Panther*, were found to be fully combat-worthy. The aircraft carriers were de-cocooned, and appropriations for the Navy's air arm raised by 30%.

1951—52:

The 60,000-ton carrier project was taken up again by Admiral Sherman in 1951. The first of the class, the *Forrestal*, was laid down on July 14th, 1952. Navy Secretary Dan Kimball prepared a programme for ten strategic carriers.

1953:

Renewed offensive by the aircraft carrier's adversaries, set off by Alexander de Seversky after Exercise "Mainbrace" in the North Sea — without result.

1954—56:

The Kimball programme for ten carriers of the *Forrestal* class has continued, under the efforts of Admiral Radford and with the backing of President Eisenhower. The *Forrestal* was launched on December 11th, 1954 and commissioned on October 1st, 1955. Four others follow:

— *Saratoga*, laid down at the end of 1952, commissioned on April 14th, 1956;
— *Ranger*, laid down in 1954, commissioning scheduled for 1957;
— *Independence*, laid down 1955, to be launched this year;
— *Kitty Hawk*, laid down 1955, to be launched in 1957;
— a sixth (not yet named), to be laid down before the end of 1956.

[1] Similar vicissitudes, though less violent, have been experienced in the British and French navies (see table).

Until France can complete her aircraft carriers *Clemenceau* and *Foch*, the French Navy is operating former U.S. and British light carriers, *Lafayette* (ex-*Langley*, left) and *Arromanches* (ex-*Colossus*, right). In the background the French cruiser *Georges Leygues*.

The French Navy's *Aquilon* version of the de Havilland *Sea Venom* built under licence by S.N.C.A. du Sud-Est.

The last four of the ten will be atomic-powered.

The anti-submarine aircraft carrier

The violent controversy surrounding the "strategic" carrier did not touch the light carrier in so far as its employment was restricted to antisubmarine missions in the form of either escort for shipping convoys or offensive units known as "hunter-killer" groups.

General Bradley, who was Chairman of the Joint Chiefs of Staff in Washington at the time of the 1949 "battle", told the Vinson committee that he personally was in favour of naval aviation and in particular of the Hunter-Killer task forces for anti-submarine operations, and fully supported a programme for naval air forces designed to master the submarine menace.

Thus the anti-submarine carrier was accepted without opposition. It has been adopted not only by the bigger navies (the United Kingdom has six), but also by the medium-size navies (France has three, Canada and Australia two each, the Netherlands one).

The strategic aircraft carrier

It was the Korean war which brought back into the limelight a forgotten lesson of World War II operations in the Pacific and Mediterranean, namely the aircraft carrier's ability to intervene in the land fighting in a "peninsular" war.

The lessons of Korea resuscitated the "strategic" aircraft carrier, of which the *Forrestal* class, being designed as such, is the supreme example; the category, however, will also include the three 45,000-ton *Midway* class carriers, which will reach 50,000 tons after modification (the first to be modernized was the *Franklin D. Roosevelt* whose conversion was begun in 1954 and completed in April 1956).

As building of the *Forrestal* class is scheduled to continue at the rate of one a year, the United States will probably have a total of thirteen strategic aircraft carriers seven years from now.

The growing displacement of aircraft carriers

One feature of recent aircraft carriers is the progressive increase in their displacement during the past few years, to enable them to "operate" heavier aircraft.

Two successive series of modifications to the *Essex* class carriers have raised their initial 27,000 tons first to 30,000 tons through the reinforcement of their decks, and later to 36,000 tons with the addition of angled decks, steam catapults and enclosed bows to provide better protection against atomic radiation. Some of them, such as the *Oriskany,* will even be increased to 40,000 tons.

Modernization of the *Midway* class, which includes not only the addition of an angled deck but also the installation of a third catapult, will raise their displacement from 45,000 to 50,000 tons.

The British *Centaur* class, originally of 18,500 tons, now displace 20,300 tons. Finally, the 1955 plan for France's *Clemenceau* sets displacement at 22,500 tons, whereas in the 1950 design 18,500 tons was considered sufficient.

Nevertheless, tonnage is kept down to the minimum. When Admiral Arleigh A. Burke, Chief of Naval Operations, was asked recently[2] whether aircraft carriers would get bigger and bigger, he replied:

A: No, not bigger and bigger. We would like to have the smallest possible carriers.

Q: You go in for the small carriers?

A: Well, no, we can't — we'd like to have the smallest possible carrier, and the smallest possible carrier right at the moment is a carrier just about the size of the *Forrestal.* And the reason is that the new aircraft are so heavy, they land so fast, that in order to have any significant number of aircraft on a carrier, the carrier must be just about the size of the *Forrestal.*

Now if we can develop some way of handling those aircraft with smaller carriers, then we will go to smaller carriers, because, for our purposes, the smaller the ship the better we would like it."

This is the problem of the sixties.

The performance of carrier-based aircraft

What aircraft will be used aboard carriers during the next three years?

For *fighter* operations, the United Kingdom at present uses the Hawker *Sea Hawk* light subsonic interceptor, with straight wing and powered by a Rolls-Royce *Nene.* This type is scheduled for replacement by the Vickers Supermarine N.113 heavy fighter with two *Avon* jets.

France has selected the *Aquilon,* S.N.C.A. du Sud Est's improved version of the de Havilland *Sea Venom,* built under licence in France.

The United States have a whole range of already classic aircraft, from the straight-wing McDonnell F2H-3 *Banshee* and the swept-wing

[2] In an interview with "U.S. News and World Report" May 4th, 1956.

Fairey *Gannet* three-seat anti-submarine aircraft.

Deck landing by the Short *Seamew* light naval combat aircraft.

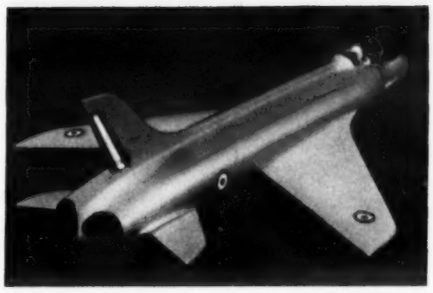
Hawker *Sea Hawk* naval fighters on the parking area of H.M.S. *Implacable.*

F9F *Cougar* to the tailless Chance Vought F7U *Cutlass*, the delta-wing Douglas F4D *Skyray* and the swept-wing McDonnell F3H-2N *Demon*. Entry into service of the last two was delayed by trouble with the Westinghouse J-40 engines which had originally been chosen to power them but which had to be replaced by the Pratt & Whitney J-57. All these aircraft are still in the transonic class, the fastest being the *Skyray*.

The U.S. Navy's supersonic prototypes in 1956 are the Grumman F11F *Tiger*, the Chance Vought F8U *Crusader* and the Douglas F5D — the latter an enlarged successor to the F4D, which did not give full satisfaction on its carrier trials at the end of 1955.

These prototypes reach Mach 1.5 — or at any rate the F8U *Crusader* has done so at the time of writing — which is quite outstanding for a carrier-based aircraft today. The *Crusader* has a variable-incidence wing, which provides extra high lift during a deck landing approach. The wing is extremely thin and very sharply swept, but the fuselage is more than 55 ft. long. Such a length can be handled only because modern carriers have external elevators.

The Douglas F5D will be a larger, improved version of the *Skyray*, with a more powerful engine, the General Electric J-79. The latter will also power the Chance Vought *Crusader* and the Grumman *Tiger*, the first models of which had the Pratt & Whitney J-57.



Model of the Bréguet 1100 *Taon* light twin-jet ground attack and naval combat aircraft.

Model of the Dassault *Etendard II* light twin-jet ground attack and naval combat aircraft.

The ideal *strike aircraft* was long considered to be a propeller-driven machine such as the *Skyraider*, of which Douglas has delivered more than 3,000 to the U.S. Navy. The most recent models will still be used in the *Forrestal*.

The Douglas A4D *Skyhawk* is a light jet attack aircraft which, despite its low weight, can carry a tactical A-bomb. This aircraft beat the world speed record over a 500-kilometre circuit on October 15th, 1955, with a speed of 1,119 km/h, thus proving once again that carrier-based aircraft can match the performance of their land-based fellows.

The best example of a heavy attack aircraft is the transonic Douglas A3D *Skywarrior*, which appears to be a particularly successful design. It is built in several different versions, including the 2P for photographic reconnaissance and the 2Q for electronic counter-measures.

The U.S. Navy expects that aircraft flying at Mach 2 will be under test by 1960 and in service by 1966.

Europe's naval air services are less ambitious

This wide range of high performance carrier-based aircraft, among which the leading places are held by manufacturers with long experience of designing for the Navy, cannot be matched in Europe's naval air services.

Britain's Supermarine N.113D has an interesting innovation, the use of air bled off the compressor and blown over the wing for boundary layer control. But its high weight of 11 to 12 tons limits its employment. It completed its sea trials aboard the carrier *Ark Royal* in May 1956. A more successful formula would seem to be that derived from the Folland *Gnat* light fighter, which has been used by Bréguet in its 1100 *Taon* and by Dassault in its *Mystère 22* (now known as *Etendard II*).

The European aircraft industry has preferred to tackle simpler problems, such as those raised by the requirements of anti-submarine warfare. This policy has led to the successful development of the Fairey *Gannet* in the medium-heavy class, the light Short *Seamew*, and the Bréguet 1050 which is to succeed the Grumman TBM now employed by the French Navy for anti-submarine duties.

In European waters anti-submarine aircraft must be capable of operating from small carriers such as France's *Arromanches*. The weight of anti-submarine aircraft today reaches 10 tons in the *Gannet* and 11 tons in the Grumman S2F *Sentinel* twin-engine version. The latter has replaced the Grumman AF1-S and AF2-WS aboard the U.S. Navy's carriers.

There is still room for small carriers

In the face of the broad development of the naval air arm in particular in the United States, the other navies, which were previously somewhat sceptical about the future of the aircraft carrier and the need for a naval air arm, have followed suit. In France the events in Indo-China helped to convince the last doubting Thomases. Until such time as France can build her own aircraft carriers, the French Navy is operating light carriers supplied by the United States, the *La Fayette* in 1951 and the *Bois Belleau* in 1953. The 1956 budget provides not only for the 22,500-ton *Clemenceau* and *Foch* but also for the laying down of a helicopter carrier, the *Jeanne d'Arc*. The latter will be a mixed vessel, probably having the bows of a conventional cruiser with the stern of an aircraft carrier.

Italy is still undecided. At present, the Italian Air Force jealously guards its privileges and refuses to permit the Navy even to pilot an aircraft. Germany has more clearly understood the lesson of World War II, when Goering even deprived the Navy of the modest air arm which Grossadmiral Raeder had succeeded in building up in 1938.

France has stuck to the right track, and during the past four years the Naval Staff under Admiral Nomy has built up an efficient fleet air arm.

Vicissitudes in Carrier Construction

UNITED KINGDOM

Eagle laid down in 1942 — suspended in 1946 — resumed in 1950, commissioned in 1952 — refitted with angled deck in 1956.

Ark Royal (36,800 tons) laid down in 1943 — suspended in 1946 — launched in 1950 — commissioned in 1955 with angled deck.

Albion, Centaur, Bulwark (20,330 tons) laid down in 1944-45 — launched in 1947-48 — work suspended then resumed — commissioned in 1954 with angled deck.

Hermes laid down in 1944 — suspended in 1946 — work resumed in 1952 — launched in 1953 — commissioned in 1955.

FRANCE

Clemenceau No. 1. A first project for 18,500 tons submitted in 1951, rejected in 1952.

Clemenceau No. 2. A new project for 22,500 tons prepared and approved in 1953. Laid down in 1955. Commissioning scheduled for 1958-59.

Foch. To follow in 1956. Commissioning scheduled for 1959.

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INTERAVIA

REVIEW OF WORLD AVIATION

U.S. Naval Aircraft in Anti-Submarine Warfare

"Aircraft approaching, take her down!"

Orders like this were given many times during World War II by Axis submarine commanders. When the submarine skipper of the period was forced to submerge, he usually had to abandon or delay any plans for attack and other missions until he was able to resurface many hours later. This delay was often enough to permit safe passage for Allied ships and was the immediately perceived advantage of aircraft in Anti-Submarine Warfare (ASW). Aircraft have, since this time, taken on additional importance in ASW.

The U.S. naval ASW aircraft forces of early war days were largely composed of aircraft designed for other missions: carrier based bomber, torpedo, scout and even fighter types were pressed into service for ASW missions.

As the seriousness of submarine warfare became more apparent, emergency modifications were made in carrier and patrol aircraft to configure them better to accomplish the ASW mission. Specialized ASW aircraft thus evolved. Since that time, the U.S. Navy has developed aircraft designed specifically for ASW and has exploited the capabilities of lighter-than-air (airships) and rotary wing aircraft in the various ASW roles.

The stable of modern ASW aircraft in use in the United States today includes the following:

P2V (Neptune) Twin engine patrol landplane equipped with MAD, sonobuoys and radar, and capable of long endurance. For increased speed, some versions are fitted with two auxiliary jet engines.

P5M (Marlin) Twin engine patrol seaplane equipped with MAD, sonobuoys and radar, and capable of long endurance.

S2F Twin engine carrier based airplane equipped with MAD, sonobuoys and radar, and of medium endurance.

HO4S and the later HSS Single rotor helicopter, usually carrier based, equipped with sonar, and capable of medium endurance.

ZPG and ZS2G Lighter-than-air aircraft (airships) equipped with MAD, sonar, sonobuoys, and radar, and capable of very long endurance.

AF-2S and AF-2W Older single engine carrier based aircraft for team tactics in search and attack against submarines. Capable of medium endurance.

ZSG Older airship equipped with MAD, sonar, sonobuoys, and radar, and capable of long endurance.

The evolution of such specialized aircraft in the U.S. Navy is testimony of the importance placed on air ASW. These specialized designs have emphasized equipment installation for detection, localization and attack of submarines. Included within the confines of modern aircraft are equipment systems which detect submarines by means of underwater acoustics (sonobuoys and sonar), specialized radar, and submarine magnetic anomaly detector (MAD).

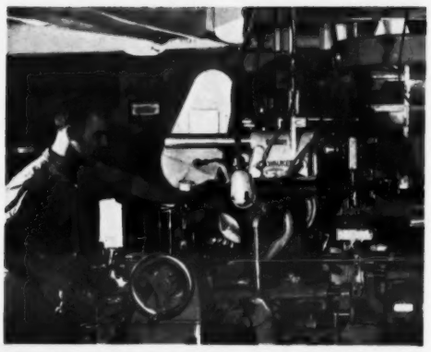
Martin P5M-2 *Marlin* patrol seaplane.

The appearance of the nuclear powered submarine in the naval warfare picture poses increasingly difficult problems for anti-submarine forces. Many of the airborne means for detection are denied the submarine seeker when the capabilities of this true-submersible nuclear powered submarine are fully exploited. Visual and radar search (which presently accounts for the bulk of initial detections) are made virtually useless. The nuclear "boat" may proceed freely and at high speed without exposing itself on the surface. Active underwater means of detection are necessary. The U.S. Navy has the view that the relatively high speed of its aircraft coupled with suitable detection equipment holds great promise against the increased speed and elusiveness of the nuclear submarine. The snorkel submarine is today's primary target. The nuclear submarine, a true submersible, will be tomorrow's primary target. Emphasis is therefore being placed upon active underwater detection capability for modern ASW aircraft.

Lockheed P2V-7 *Neptune*, one of the U.S. Navy's standard land-based anti-submarine aircraft. Also in service with a number of European countries (e. g., R.A.F. Coastal Command and French Navy).

Airships equipped with search devices render valuable services in the detection of submarines. A Navy blimp operating from U.S.S. *Forrestal*.

The 32,000-ton CVA-14 *Ticonderoga* anchored off San Remo, Italy, earlier this year.



Aircraft carriers of this size have fully equipped machine shops capable of making all but very heavy components needed to keep the ship in operation. The CVA-14's machine shop was working 24 hours a day.

Life Aboard

"Would you show me the way to the main railway station?", we felt tempted to ask the deck officer after we had climbed from the barge up the steps to the vast hangar deck of U.S.S. *Ticonderoga*, also known as CVA-14. While the "Ti", with her 32,000 tons, is not one of the largest U.S. aircraft carriers and not even a very modern one (she has now gone to Jacksonville to be refitted, complete with angled deck, etc.), everything aboard her is huge, from the hangars and engine rooms to the crew messing halls and galleys.

With a complement of 2,700 men (about 300 below strength), a carrier of this size is a complex organization—more complicated than a small town because the "administration" has to take care not only of rudimentary utilities but also has to provide work, quarters, food and relaxation for its "inhabitants". About 200 of the total are officers, the others petty officers, and men; fifty of the officers are Lieutenants, 100 Lieutenants Junior Grade, the balance Lieutenant-Commanders and higher ranks. Six hundred, including 100 pilots, form the ship's Air Group, i. e., they are responsible for flying and operating the 60 aircraft constituting the four combat squadrons (one squadron F2H-3 all-weather *Banshees*, one F9F-8 *Cougars*, one F7U *Cutlasses* and one AD-6 *Skyraider* attack aircraft) and supplementary detachments

Left: Captain A. McB. Jackson, Commanding Officer of the *Ticonderoga*, on the bridge; *right*, Commander H. C. Miller, Executive Officer.

The captain's stateroom, used for conferences with the senior officers aboard. Adjoining is a bedroom and the captain's private galley.

A fully equipped aerology office provides weather reports to the Commanding Officer, the Air Group and the ship's navigating crew.

Seamen practising loading of 5-inch guns aboard the *Ticonderoga*.

Aircraft maintenance crew working on a *Banshee* on the flight deck. Major overhauls are carried out below.

Stern portion of CVA-14's flight deck, here at Beirut. Visible are Douglas AD's, three North American AJ-1 tankers, Grumman F9F-8's and McDonnell F2H-3's (nearest camera).

The master control panel in the engine room. The ship's turbines deliver 150,000 shaft horsepower, drive four propellers.

a Carrier

Men on a 3-inch anti-aircraft gun mount of the CVA-14 during General Quarters (i. e., every man at his post). In addition to twenty-eight 3-in. guns, the *Ticonderoga* has eight 5-in. guns (in background on photo) and seventy-two 40-mm guns. For her aircraft she carries "special weapons" (atomic).

(e. g., tanker aircraft, photo reconnaissance, etc.); 475 men, including 13 officers, form the ship's Air Department and are in charge of aircraft maintenance and similar work. The rest are concerned with the operation of the ship itself.

When the ship is operating, e. g., in training or on manoeuvres, life aboard is tough but interesting. Reveille is normally at 0400 hours, at 0630 the "squawk boxes" call the pilots from the ready room to their aircraft, and at 0700 aircraft begin to be launched at 30-second intervals with the new steam catapults. Operations go on all day, and often more than 130 sorties are flown. At about 2130 hours the flight deck crews "respot" the aircraft on the flight deck or in the hangars for the next day. Lights out can be as late as 2400 hours.

Sundays are normally off and the personnel go on "liberty" when the ship is in port. In addition, there are daily movie shows, basket ball matches and lectures on the hangar deck; libraries and lounges offer calmer forms of relaxation. Some of the men naturally gripe, as in every armed service of the world, and when we told one seaman that we wanted to study life aboard an aircraft carrier he said — "Jeez, don't." Afterwards he admitted that he liked being in the service.

Officers having dinner in the ward room. Messing costs an officer $ 30.00 a month. There is no alcohol aboard.

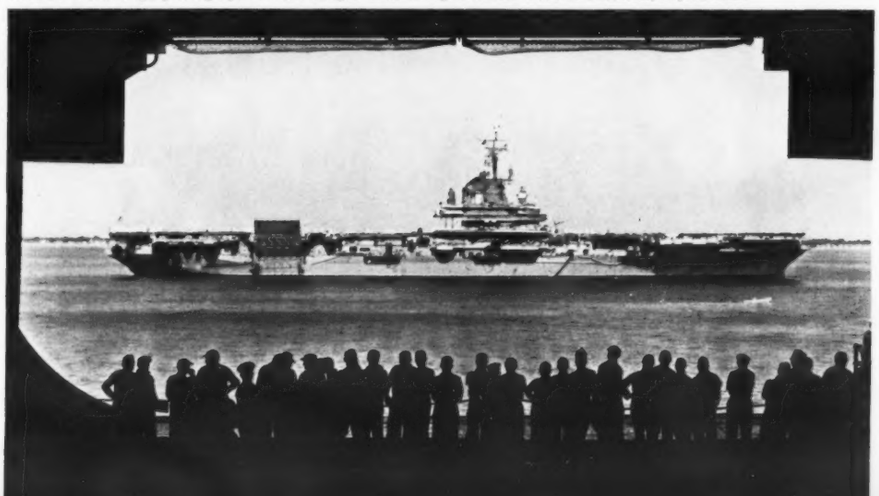
Crew mess aboard CVA-14. Food is free – and much more plentiful than in the officer's ward room.

Ship's servicemen working in the main laundry on board CVA-14.

Crew lounge and library on the *Ticonderoga*. Library is well stocked with books ranging from Hindu philosophy to detective novels.

Pilots in the "ready room" attending a lecture. There are four ready rooms, one for each squadron. Under operating conditions pilots wear full flight gear, move to the flight deck on escalators to prevent them from perspiring.

CVA-14 *Ticonderoga* photographed from hangar deck of super-carrier CVA-59 *Forrestal*, 60,000 tons.



Guided Missile Vessels

The Guided Missile Cruiser

On November 1, 1955, there occurred at the Naval Shipyard, Philadelphia, Pennsylvania, an event of great significance to the future of the United States Navy. On that day the USS *Boston*, the first cruiser in world history to be equipped with surface-to-air guided missiles, was placed in commission.

The *Boston* was originally commissioned during World War II, and fought as a heavy cruiser during the last half of the war in the Pacific. After the war she was placed "in mothballs" as a unit of the reserve fleet.

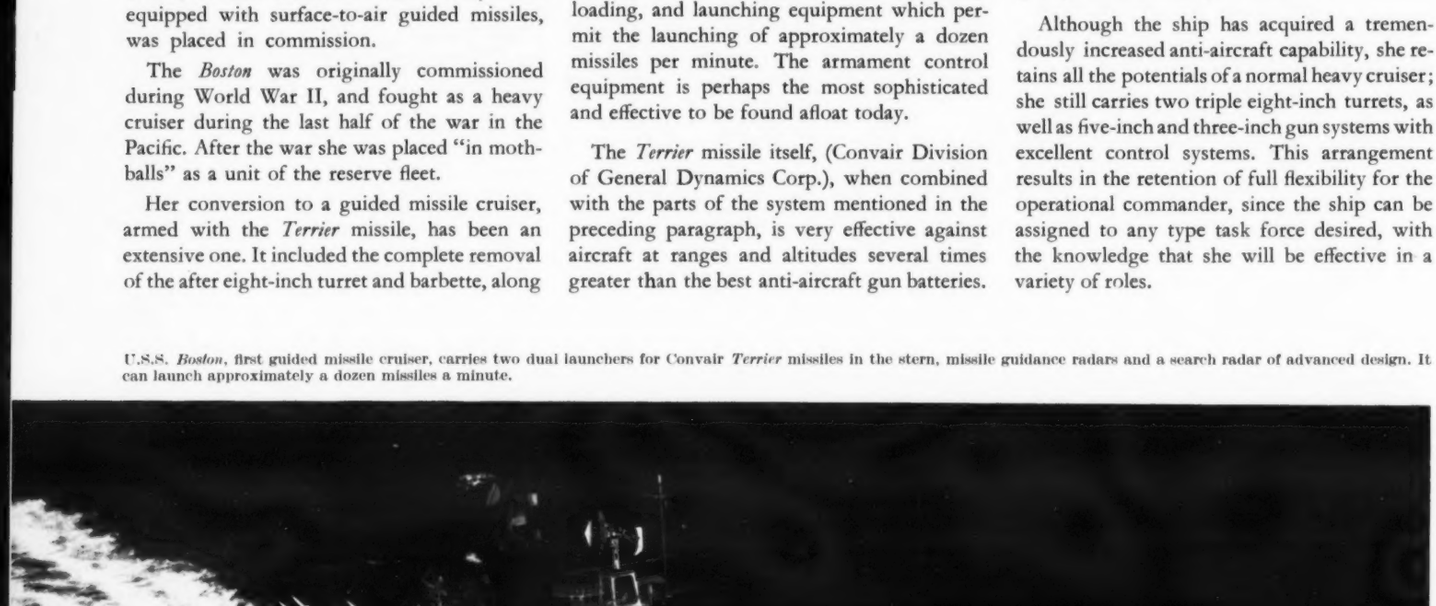
Her conversion to a guided missile cruiser, armed with the *Terrier* missile, has been an extensive one. It included the complete removal of the after eight-inch turret and barbette, along with certain five-inch and three-inch anti-aircraft mounts, and the substitution of two dual launchers for *Terrier* missiles. Also added are two missiles guidance radars and a search radar of advanced design. Tremendous fire power is accomplished through automatic handling, loading, and launching equipment which permit the launching of approximately a dozen missiles per minute. The armament control equipment is perhaps the most sophisticated and effective to be found afloat today.

The *Terrier* missile itself, (Convair Division of General Dynamics Corp.), when combined with the parts of the system mentioned in the preceding paragraph, is very effective against aircraft at ranges and altitudes several times greater than the best anti-aircraft gun batteries.

The *Boston* has now completed a lengthy shakedown training period during which she demonstrated her capabilities repeatedly to representatives of the news media, the Congress of the United States, and numerous groups of technical personnel.

Although the ship has acquired a tremendously increased anti-aircraft capability, she retains all the potentials of a normal heavy cruiser; she still carries two triple eight-inch turrets, as well as five-inch and three-inch gun systems with excellent control systems. This arrangement results in the retention of full flexibility for the operational commander, since the ship can be assigned to any type task force desired, with the knowledge that she will be effective in a variety of roles.

U.S.S. *Boston*, first guided missile cruiser, carries two dual launchers for Convair *Terrier* missiles in the stern, missile guidance radars and a search radar of advanced design. It can launch approximately a dozen missiles a minute.



The *Boston* is but the first ship of the United States Navy's new surface-to-air guided missile force. She will soon be joined by her sister-ship, the cruiser *Canberra* which, although essentially similar, has already had certain improved features incorporated. Following these two ships there will be during the next few years dozens of surface ships of the cruiser, battleship, frigate, and destroyer classes, armed with a variety of missiles of varying capabilities. Certain of the missiles will actually reach out into the zones formerly covered only by interceptor aircraft; and some of the ships will carry long-range surface-to-surface missiles.

The *Boston* is now a fully trained effective unit of the United States Atlantic Fleet. It is planned that she will be deployed to the Sixth Fleet in the Mediterranean in the autumn of 1956.

The U.S. Navy has converted a number of conventional submarines for missile warfare. Picture shows a Chance Vought *Regulus* immediately after launching.

Guided Missile Submarines

At the end of World War II, a group of officers in the U.S. Navy foresaw that the bringing together of the submarine and the guided missile would form a weapon combination which could be a powerful factor in another major conflict. The most suitable missile available at the time was the German V-1 "buzz bomb". An American adaptation of this weapon, named *Loon*, was fitted for shipboard launching and two submarines, USS *Carbonero* and USS *Cusk*, were equipped with launching rails and radio command guidance systems. Operations with *Loon* were conducted for the purpose of training submarine personnel, evaluating shipboard equipment, and testing missile components.

Loon had a maximum range of 135 miles. It was powered by a single pulse jet engine and attained a top speed of 360 knots at altitudes up to 12,000 feet. In 1949, the attention of the entire U.S. Navy was focused on the guided missile submarine when a *Loon* launched from the USS *Carbonero* passed over the Pacific Fleet engaged in Operation *Miki* near the Hawaiian Islands.

After these early experiments proved the ability of submarines to use weapons of this type successfully, development was started on a new, higher performance missile for submarines. Chance Vought Aircraft Company designed a turbo-jet powered missile, *Regulus*, which fulfilled the Navy's requirements. *Regulus* is a swept-wing, high performance fighter-type missile capable of delivering an atomic warhead at a range of several hundred miles.

Experience from *Loon* operations was also applied to design of improved handling, launching and control equipment for a missile submarine, and, on March 6th, 1953, a converted World War II submarine, USS *Tunny*, modernized by the addition of snorkel and streamlining, was completed at Mare Island Naval Shipyard. *Tunny* was followed by conversion of three other submarines to carry *Regulus*. One of these, USS *Barbero*, was converted from a World War II fleet type submarine; two others, USS *Grayback* and USS *Growler*, are being converted from post-war, conventional attack submarines.

Chance Vought *Regulus* aboard the aircraft carrier U.S.S. *Hancock*. Launching is by steam catapult.

Two *Terrier* missiles ready for launching from U.S.S. *Mississippi*.

Missile away! Firing the *Terrier* anti-aircraft missile from U.S.S. *Mississippi*.

Future development in the field of the submarine guided missile weapon system can take several forms.

First, there will be improvement in the missile. It can be made to go faster, higher and farther. As different "yield" warheads become available, it can employ them. There can be changes in the type of missile: it could be shifted to the ballistic family. Long range missiles of this type are chronically beset with problems of accuracy and heating, problems which are greatly reduced in shorter range versions. The submarine, with its capability for unobserved operations in enemy waters, can deliver such shorter range versions. Submerged-launched missiles are a logical development for submarine use. Their application, depending on accuracy and range obtained, can vary from sinking of a nearby ship to destruction of important shore facilities.

The second area for obvious improvement is in the launching vehicle. The provision of a "true" submersible missile launcher will greatly improve the probability of successful delivery of submarine launched missiles. The ever-pressing requirement for air for the propulsion plant hazards the operation of any diesel-driven submarine. Sufficiently fine surveillance of the surface of the water may detect even the most carefully used snorkel. It is only natural that this improvement in the delivery vehicle should be forthcoming. In keeping with its accelerated program to expand the application of nuclear power in the fleet as quickly as possible, the U.S. Navy is constructing a nuclear powered guided missile submarine.

In conclusion, the submarine-missile weapon system promises to restore to naval striking forces the mantle of secrecy which has recently been ravelled by improvements in the over-water search capabilities of the aircraft.

Role of High Performance, Water-Based Naval Aircraft

The adaptation of jet power to seaplanes has opened new horizons, and promises aircraft which, for the first time, will permit the integration of water-borne aircraft into a high performance weapons system. A new look is being given to the attractiveness of having a high performance aircraft capable of being operated from the water areas of the earth. With jet power, an aerodynamic approach to the problem rather than an approach limited to hydrodynamic considerations is possible. This approach envisions a high performance aircraft which can operate from the water, rather than a boat which can fly. The first such aircraft, the P6M *Seamaster,* is being built for the U.S. Navy.

The *Seamaster* is a high speed minelayer and reconnaissance aircraft which can carry a 30,000-pound payload at 600 mph*. It is manned by a five man crew. Built by the Glenn L. Martin Company of Baltimore, the plane is the first multi-jet attack seaplane. Powered by four turbo-jet engines, it is designed to cruise at 40,000 feet and it features the Martin-developed rotating mine-bay door.

Simultaneously with the *Seamaster,* new seaplane handling equipment is being developed. This equipment includes a beaching vehicle enabling seaplanes to beach themselves under their own power, and a service and dry dock facility for use in semi-sheltered areas in conjunction with seaplane tenders.

In operation, the beaching vehicle will be moored unattended in the water near a seaplane ramp. The seaplane will taxi between horizontal flotation tanks, engage the beaching cradle, and then proceed up the ramp under its own power.

The service and dry dock will contain padded wing carts, which are secured beneath the plane's wing and move forward with the aircraft as it enters the docking area. The dock will remain partially submerged, and a series of hull pads, which can be operated individually, will be raised from beneath to secure the aircraft.

The advent of the P6M, a high performance seaplane which can operate from mobile bases, has excited the Navy's imagination and has produced many seaplane enthusiasts. There are tremendous advantages to be achieved in its employment, the first and foremost being operational mobility. Fixed bases are vulnerable, especially those within easy aircraft and missile range of enemy territory. There is rigid immobility about any fixed geographic position, the enemy knowing the exact latitude and longitude. Mobility, even the capability to move just a few miles, to make your exact position unknown, or to be able to disperse, is becoming an increasingly vital factor in warfare.

The inherent advantages of seaplane operations lie in the fact that the sheltered coastal waters of the world provide almost unlimited, relatively indestructible, landing and take-off areas. Associated with this fact are numerous operational advantages, such as:

1. Seaplane range and strike capability can be extended by employment of tanker submarines or strategically located fuel barges or caches, and by in-flight refueling.

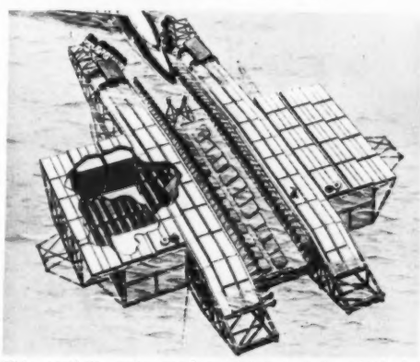
2. Preparation of operating areas for widely dispersed seaplane operations is less costly in equipment, materials and labor than equivalent land bases.

3. Seaplane transports, submarines and surface units could be used to full advantage in logistic support, and

4. In certain instances it might be possible to operate seaplanes in areas where land air base construction would encounter diplomatic delays or refusals.

In nuclear war, it is possible that the outcome will be settled in a very short span of time. In this situation, a pre-dispositioned seaplane striking force would constitute a most effective deterrent to surprise attack by any potential enemy.

The jet-powered seaplane is a "high-performance aircraft which can operate from the water, rather than a boat which can fly. The first such aircraft, the Martin P6M *SeaMaster,* is being built for the U.S. Navy".



This partially submerged servicing and dry dock for seaplanes will serve as an integral part of the Navy's concept of mobile seaplane striking forces.

Convair R3Y-2 *Tradewind* turboprop seaplane assault transport, with four Allison T-40 turboprop engines. Door in the nose allows for the loading and unloading of troops and material direct on the beach.

"Able to operate from the seas, lakes and rivers, the *SeaMaster* possesses the flexibility inherent in seaplanes together with performance comparable to that of its landplane contemporaries."

* Statistics: Length: 134 feet (40.8 m), Height: 31 feet (9.4 m), Hull width: 10 feet (3.1 m), Span: 100 feet (30.5 m), Wing area: 1,900 sq. feet (176.5 m^1), Vertical tail area: 213 sq. feet (198 m^2).

The U.S. Marine Corps has developed a vertical envelopment assault concept of warfare. The Sikorsky S-55 (Marines designation HRS-1), operating from helicopter carriers, can transport 8 to 10 troops plus such infantry weapons as machine guns, rocket launchers and anti-tanks arms.

The Assault Helicopter Aircraft Carrier

Assuming that a future war will *not* be terminated in a matter of hours through an all-out atomic blitz, and further assuming that it will be still a requirement physically to employ troops in the seizure, occupation and holding of specific sections of an adversary's real estate, the Marine Corps has developed a vertical envelopment assault concept of warfare; and the Navy has produced an Assault Helicopter Aircraft Carrier to effect its accomplishment. By utilizing an airborne machine possessing the unique characteristics inherent in the helicopter, the Marines have determined that the enemy now may be subdued through vertical attack not only from above, but on both flanks, and from the front and rear simultaneously. An impregnable defense against such a multi-capable assaulting force should pose almost insurmountable problems.

And what would be the disposition of an Amphibious Task Force to mount such an attack? Quite logically, because of the danger of atomic attack, the shipping would be widely dispersed over an area which could conceivably embrace hundreds of square miles. Because of the ability of the helicopter to launch at sea far from the objective area, to have aerial rendezvous and departure points, and — most important — to be able to alight not just on as restrictive an area as a beach, but to be able to approach from any direction and to land in hundreds of places, the tenability of the defending forces would be subject to conjecture.

What would comprise the core of the Task Force? Assault Helicopter Aircraft Carriers (CVHA), or as they will be termed subsequently Amphibious Assault Ships (LPH), will constitute the core of the entire Amphibious Task Force.

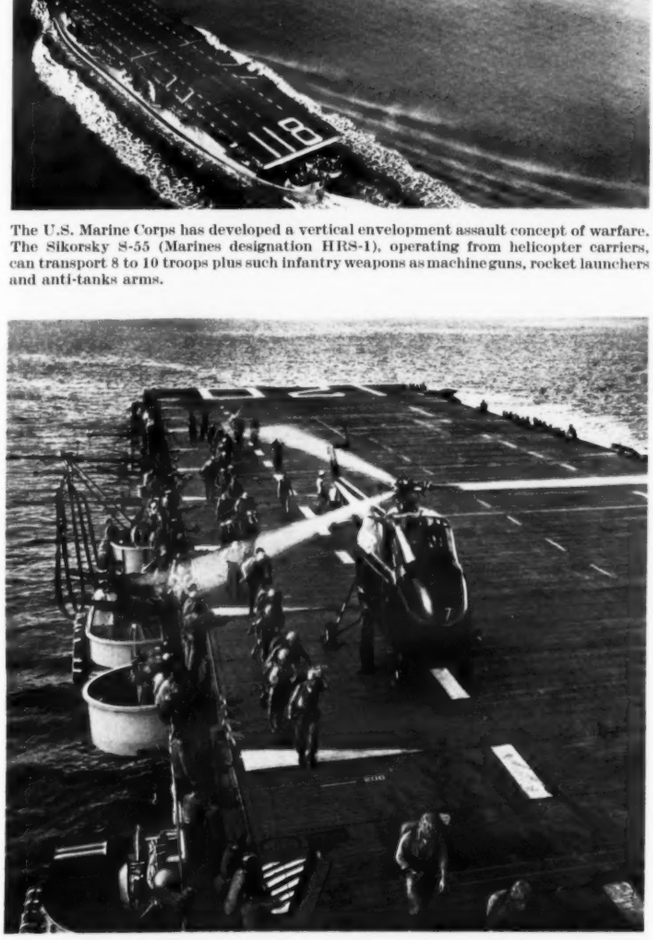
The mission of the CVHA (or LPH) is clear and concise: To embark, transport and land troops and their essential air transportable equipment and supplies in all weather assault by means of embarked assault transport helicopters of the landing force.

The designed task will include loading aboard the assigned number of troops to be landed from each ship, together with the number of helicopters to be operationally supported and maintained; a limited self-defense capability against enemy air and light surface attack; maintenance facilities for embarked helicopters; and accommodations and command facilities for the amphibious squadron commander and the Helicopter Assault Force Commander.

From the foregoing mission and designed tasks it will be noted that each Amphibious Assault Ship will be capable of operating independently for a specified period, separate from other elements of the Task Force. The advantages which thus accrue from this capability further adapt the new ship for successful employment of the vertical envelopment assault concept of warfare.

In 1954, when the requirement was generated to provide the necessary platform to support helicopter operations and to provide space for the troops, it followed quite logically that conversion of an already existing carrier would be in order. CVE 90, the *Thetis Bay*, was selected for conversion. This ship was one of a number of escort aircraft carriers built by the Henry J. Kaiser Company at Vancouver, Washington, and by the Oregon Shipbuilding Corporation at Portland, Oregon, but unlike the earlier mercantile-hulled CVE's, was designed from the keel up as an escort carrier. She was laid down in December 1943, launched in March 1944, and completed in April 1944. Rather rapid construction for a ship displacing 7800 tons, but around the clock war time working shifts made such feats the rule rather than the exception.

When the fiscal 1955 military budget authorized conversion of one CVE to an Assault Helicopter Aircraft Carrier, the CVE 90 entered the San Francisco Naval Shipyard in June 1955 for the necessary conversion processes. In February 1956 *Thetis Bay* was redesignated CVHA 1; and in September 1956 the first of a new type aircraft carrier will steam forth on shake down runs in furtherance of a new concept of warefare — the vertical envelopment assault. The "test bed" is now a reality. Subsequent operations and exercises will undoubtedly determine, as was the case with the CV 1 and CVE 1, what changes and improvements are to be incorporated in subsequent CVHA's or LPH's in order to carry out most satisfactorily the mission and tasks assigned.



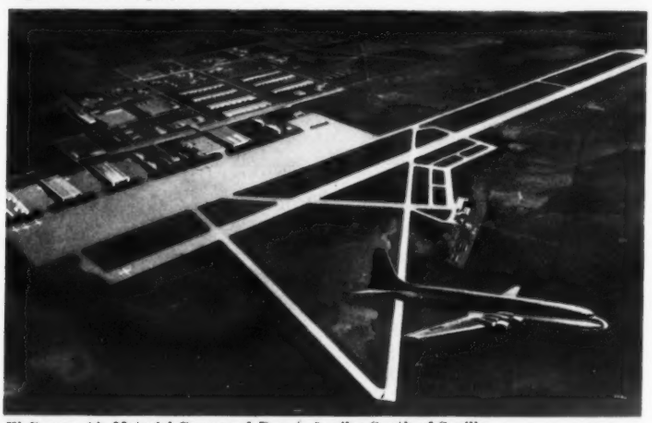
Combat-ready Marines preparing to board their helicopters for an amphibious invasion exercise.

After a surprise assault behind the enemy lines the Marines set up their light weapons.

U.S. Bases in Spain

Torrejon de Ardoz air base, an artist's conception. Architects for the U.S. bases in Spain are the U.S. firms of Shaw, Metz & Dollo; Metcalf & Eddy; Frederic R. Harris, Inc.; and Pereira & Luckman.

Zaragoza air base. The Sanjurjo civil airport (right) and the Valenzuela air base (left) together form one project.



El Copero Air Materiel Command Depot, 5 miles South of Seville.

Rota naval base, near Cadiz. Breakwater and docks in foreground, air base in middle distance, "Blimp" anti-submarine airship base in background.

Moron de la Frontera air base.

The U.S. Air Force has lifted a corner of the security veil with which it has so far shrouded the programme for the construction of air and naval bases on Spanish territory. In fact, the joint U.S. Military Group in Madrid has released five "artist's impressions" of the future bases, reproduced on this page.

The Hispano-American agreement on the use of Spanish air bases by the U.S.A. was signed in Madrid on September 26th, 1953, after nearly two years of laborious negotiation. To be valid initially for ten years with two renewal periods of five years each, it is closely tied up with other agreements according military and economic aid to Spain. The Spanish Cortes ratified it on November 30th, 1953.

Basically, the agreement calls for the construction of four U.S. Air Force bases and one naval base in Spain, as follows:

Torrejon de Ardoz Air Force Base, 15 miles east of Madrid, an existing Spanish base which is being enlarged at a cost of $ 43,000,000.

Zaragoza Air Force Base, which is a twin project inasmuch as it consists of the construction of a military air base at Valenzuela, nine miles West of Zaragoza, and the expansion of the adjacent Sanjurjo field, Zaragoza's civil airport.

Moron de la Frontera Air Force Base, 30 miles southwest of Seville.

El Copero Air Force Base, 5 miles South of Seville. This will be an Air Materiel Command Depot and together with the Moron facility will cost about $ 57,000,000.

Rota Naval Base, near Cadiz, on the Atlantic Coast, which will include a breakwater, fuel docks for tankers, pipe lines and cargo handling facilities, as well as a Navy airfield and a separate "Blimp" airship base. It will be a transfer point to handle supplies for U.S.A.F. units in Spain and Navy units in the Mediterranean.

*

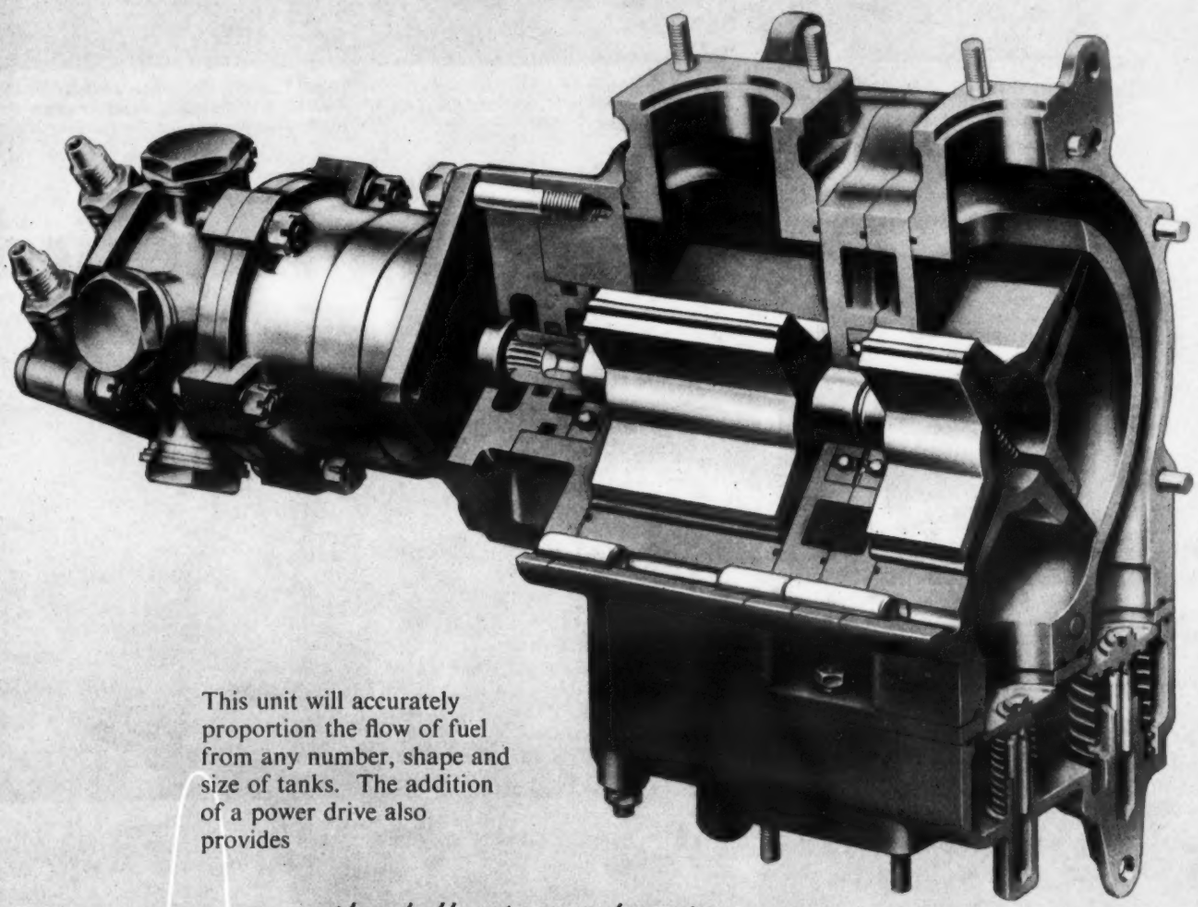
In addition to the five bases planned so far, the U.S.A. will build a 596-mile pipeline costing $ 41,000,000 to supply fuel from Rota to the various air bases. The Navy will also get a supply and maintenance centre at San Pablo, the civil airport of Seville, and two service facilities at El Ferrol in Northwest Spain and at Cartagena in the Southeast.

Construction of the bases started late in 1954 and is to be completed late in 1957. Overall supervision is in the hands of an American firm, Brown, Raymond, Walsh & Co., which was formed especially by three leading contractors. This company has awarded the actual building contracts to local Spanish firms as well as foreign companies (e.g., for pipelines).

The purpose of the bases is obvious—to provide the U.S.A.F. with a missing link in its globe-circling chain of air bases to replace or at least supplement the five bases the Air Force had previously built in what formerly was French Morocco. The five bases now building in Spain may not be all that are to be established there. In the middle of June it was reported from Madrid that the U.S.A. and Spain had reached a further agreement providing for three more air bases to be constructed for the U.S.A.F.: one by the expansion of the Spanish base at Reus, eight miles from Tarragona; one at Los Llanos, four miles from Albacete; and one at Ecija, thirty miles from Cordoba.

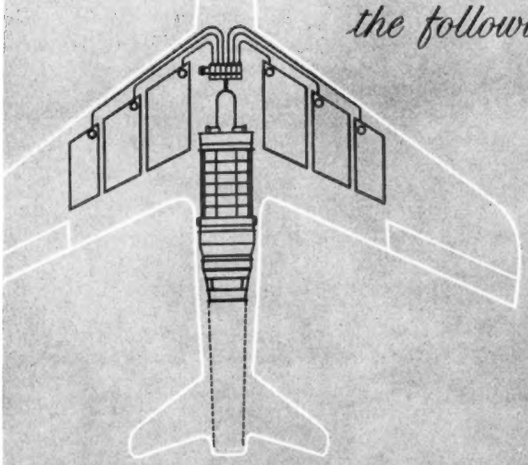
POWERED PROPORTIONER

Rotol fuel flow proportioner with hydraulic motor drive



This unit will accurately proportion the flow of fuel from any number, shape and size of tanks. The addition of a power drive also provides

the following advantages



- An alternative source of fuel pressure in emergency cases.
- Additional fuel pressure at little extra cost in weight.
- Use as a backing pump providing engine pump pre-pressure.
- Proportionate refuelling at high flight refuelling rates.
- Any desired fuel pressure rise by the choice of suitable motor.

ROTOL

GLOUCESTER · ENGLAND

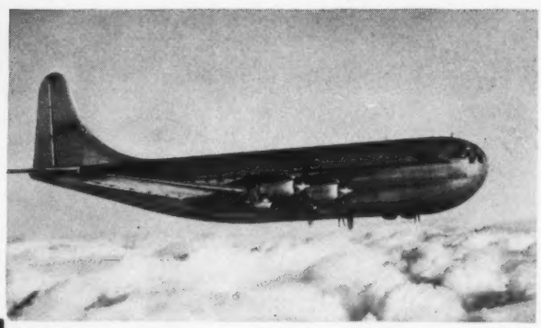
1916 Model C, pioneered international air mail service, between Seattle, Wash., and Victoria, B.C.

1927 The Boeing 40-A was one of America's earliest airplanes in transcontinental mail-passenger service.

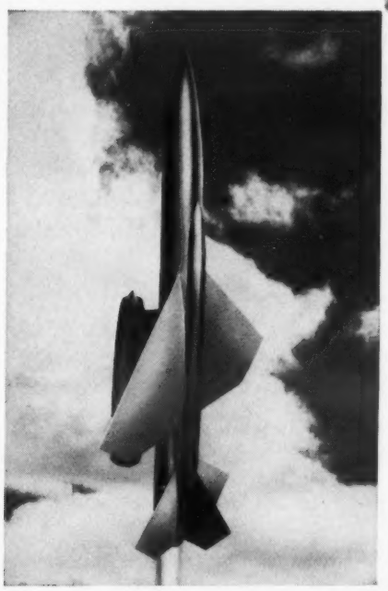
1932 The 247, *first* 3-mile-a-minute airliner, set basic design for all modern twin-engine transports.

Keeping America

1942 B-29 Superfortress, world's first nuclear weapons carrier, backbone of America's heavy bombardment force in the Pacific during World War II.



1944 The Stratocruiser, spacious double-deck airliner, famed on luxurious "name" flights. Veteran of 200,000,000 miles, more than 30,000 ocean flights.



BOMARC. Supersonic guided missile, designed to strike enemy aircraft while still over areas well away from vital targets. Performance details are secret.

1952 B-52 eight-jet Stratofortress. World's leading intercontinental bomber. Speed: over 650 mph. Operating altitude: above 10 miles. Described by defense officials as "the most formidable expression of air power in the history of military aviation."

1936 B-17 Boeing Flying Fortress, *first* modern heavy bomber. Revolutionized aerial warfare.

1939 The 307, America's *first* four-engine, pressurized transport. First four-engine airliner in transcontinental service.

first in the air

Here, climaxing an era of aviation achievement, you see America's *first* jet transport—along with other Boeings that have marked significant advances in aircraft performance.

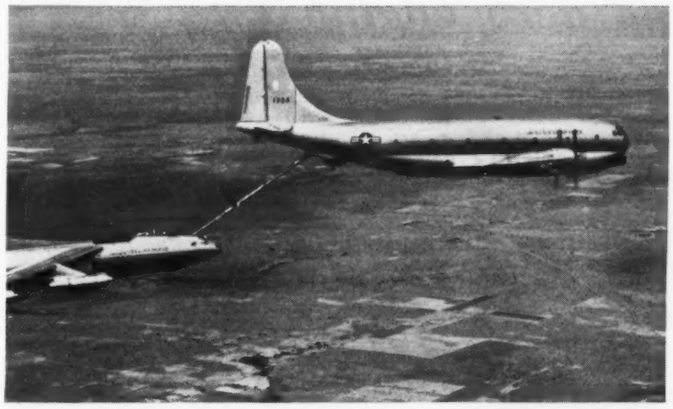
Each is a product of imaginative Boeing design and efficient production. Behind each aircraft is a tradition of leadership that began 40 years ago, when Boeing was founded. During this span, Boeing created a succession of epoch-making aircraft.

In Commercial Aviation—the pioneer 40-A; and the 247, first modern 3-mile-a-minute airliner; the 314 flying boat; the original Stratoliner, first pressurized transport; and the luxurious Stratocruiser, familiar around the world.

In Military Aviation—such trend-setting fighters as the PW-9; the revolutionary B-9 bomber, which could outspeed any contemporary fighter; the historic B-17 Flying Fortress and B-29 Superfort, culminating in today's revolutionary B-47 and B-52 multi-jet bombers.

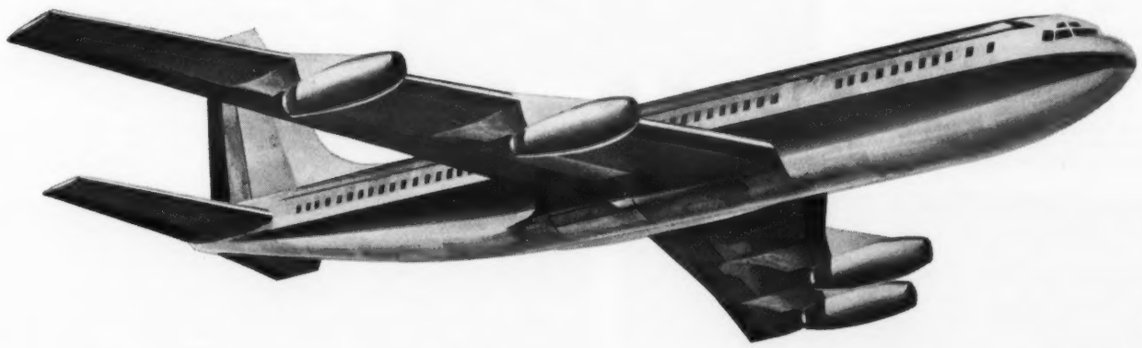
And for Tomorrow—the 707 Commercial Jet Transport, the military KC-135 jet tanker-transport, and the defense weapons system based on BOMARC, Boeing's long-range, pilotless interceptor guided missile.

Boeing's 40-year tradition of leadership continues to help keep America *first* in the air.



1947 B-47 six-engine Stratojet medium bomber, America's current front-line nuclear weapons carrier, being refueled in the air by a Boeing KC-97, standard aerial tanker of the Air Force.

BOEING



1956 The 707, America's *first* jet transport, ordered by eight airlines for delivery beginning late in 1958. Prototype holds transcontinental transport record: 3 hours, 58 minutes. KC-135 configuration will be world's first multi-jet aerial tanker.

NAPIER

announce that the

Eland

propeller turbine aero engine

has passed its official

150 hour

type test at 3,060 e.h.p.

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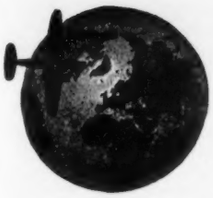


What's in the Air?*

AIR TRANSPORTATION

● *René Lemaire* has resigned from his post as France's Secretary General of Civil and Commercial Aviation, at the request of the Transport Minister. The latter is believed to be desirous of limiting the prerogatives of the Secretariat General and of turning it into a sort of administrative secretariat whose only function would be to coordinate the various directorates of civil aviation. Successor to René Lemaire, who is to be nominated Secrétaire Général Honoraire, is Paul Moroni.

● *Only one airline* is to operate in Austria, the Government has decided. Airaustria, founded by the People's Party with the aid of K.L.M., and Austrian Airways, set up by the Socialist Party with S.A.S. participation, have been asked to negotiate a merger.

● *Stuart Tipton*, President of the Air Transport Association of America, has urged Congress, federal aviation agencies and the airlines themselves to review the entire U.S. international air transportation policy and adapt it to meet the jet age. The Government should change its methods, particularly in dealing with foreign companies, Tipton told the Aero Club of Washington. He was critical of the role played by the Civil Aeronautics Board in foreign negotiations which, he said, were the responsibility of the State Department itself. Foreign governments as well as the United States Government did not take into consideration the importance of the U.S. passenger market, he added.

INDUSTRY

● At the *Association of German Aircraft Manufacturers'* annual meeting Association President Dr. L. S. Rothe again stressed that without orders for the Air Force no resurrection of the German aircraft industry would be possible. He also referred to the amalgamation of the Flugzeugbau Nord GmbH group in Hamburg, the Professor Blume and Focke Wulf group in Bremen and the Southern Group (Messerschmitt, Heinkel) which is not yet consolidated. The Association's President spoke of initial credits amounting to DM 35,000,000 which had been granted out of the defence budget, and of hoped-for orders totalling from DM 700,000,000 to DM 1,000,000,000. These figures pertain only to airframe construction. As regards jet engine production, Rothe mentioned the possibility that the BMW (Munich) and Daimler-Benz (Stuttgart) companies would participate in the programme.

● The *Advisory Committee* of the Association of German Aircraft Manufacturers was newly elected as follows : airframes : Prof. Dornier, Dornier-Werke ; Dipl. Ing. Feilcke, Weserflug ; Prof. Heinkel, Ernst Heinkel A.G. ; Prof. Messerschmitt, Messerschmitt A.G.—power plant : Dr. Bruhn, Auto-Union ; Dipl. Ing. Frydag, Henschel & Sohn GmbH ; Dir. Sachse, BMW Studiengesellschaft für Triebwerkbau ; Dir. Ing. Scherenberg, Daimler-Benz A.G.—accessories : Dir. Artur Kleppel, Otto Fuchs, Metallwerke ; Dir. Dr. Lippart, Robert Bosch GmbH ; Dr. M. Lock, Telefunken GmbH ; Dr. M. W. Nolden, Vereinigte Leichtmetallwerke.

● *Association of French Aircraft Manufacturers*, new Executive Committee elected : President, Georges Glasser, President and Managing Director of S.N.C.A. du Sud-Ouest ; Vice-Presidents, Marcel Dassault, Managing Director of Générale Aéronautique Marcel Dassault ; Henri Desbruères, President and Managing Director of SNECMA ; Paul Mazer, President and Managing Director of S.N.C.A. du Nord ; Jean Gandilhon, Deputy Managing Director of Société des Ateliers d'Aviation Louis Bréguet ; Treasurer, Robert Blum, President and Managing Director of Société d'Exploitation des Matériels Hispano Suiza ; Secretary General, André Granet. Maurice Heurteux, who had already been President of the Association for four years and was therefore not eligible for re-election according to the organization's statutes, was made an Honorary President.

● *Royal Dutch Aircraft Works Fokker, Amsterdam*, has received an order for five F.27 *Friendships* from Aer Lingus, Irish Air Lines.

● *Marconi's Wireless Telegraph Co. Ltd.* recently supplied transmitting equipment for three radio stations which are to be built in Greenland. One station is to be used for ground-to-air communications on the trans-Atlantic and the trans-Polar air routes from Europe to North America, while the remaining two will serve the new Scandinavian Airlines System Arctic route from Scandinavia to Tokyo. — The contract called for the supply of six medium-power high-frequency channelized communications transmitters type HC.205, together with drive units, remote control and aerial matching equipments. Each station will have a dual installation of type HC.205 transmitters, one for operation, one for standby. One station is to be installed at the present weather station Nord—the northernmost radio station in the world ; the second station is located on the northwest coast ; and the third is at Prins Christiansund, near the southern tip of Greenland.

● *Consolidated Electrodynamics Corp.*, Pasadena, California, has been awarded a $1,200,000 contract by the Air Research and Development Command of Baltimore, Maryland, to provide magnetic-tape instrumentation along a 5,000-mile range that will be used to test the Air Force's intercontinental ballistic missiles. The range extends southeastwards from a launching site outside the Missile Test Center, Patrick Air Force Base, Florida, across the Atlantic to Ascension Island, off the African coast. Consolidated's magnetic tape equipment, placed at more than 100 strategic points on the ground and aboard ships along the range, will record

* Extracts from *Interavia Air Letter*, daily international news digest, in English, French and German. All rights reserved.

Swissair's first Convair 440 *Metropolitan* went into regular service on the Zurich-Frankfurt-Stuttgart route in July. Above, the cockpit; the storm-warning radar screen is in the centre above the throttle controls.

For its aerial survey work in northern Canada Spartan Air Service uses three R.C.A.F. *Lancaster* bombers. The company has carried out its own modifications, including the fitting of Shoran equipment, the removal of the rear gun post and the installation of a plastic cone over the fuselage rear.

telemetered data from the missiles, such as temperature, pressure, thrust, and play it back for analysis and interpretation. Instrumentation of this type is a major development of the company's " Data Tape " programme. Consolidated first entered the magnetic tape field three years ago, introducing an air-borne unit that collects test data while in flight and a playback unit that recreates the aircraft or missile performance on the ground. Subsequently the company established the Advanced Electronic Data Laboratory, known as " Datalab ", to create advanced techniques and equipment in the magnetic tape data-processing field.

● *Bendix-Decca Navigator System* : The Pacific Division of Bendix Aviation Corporation has obtained Canadian rights for the manufacture and sale of the Bendix-Decca navigator system. A test programme was completed recently by the Canadian Army and R.C.A.F., and the system has been adopted by the Canadian Hydrographic Office, primarily for operations on the Canadian East Coast.—The Canadian Department of Transport has licensed Bendix Pacific Division, North Hollywood, California, for the manufacture and sale of Decca transmitting and receiving equipment for airborne and marine units and land vehicles. Bendix-Eclipse of Canada Ltd. is associated in the licensing agreement (the Decca System was developed in Britain during World War II, and American rights to it were obtained by Bendix Pacific in 1954).

● *Orders for two Learstar Mark 1s* have been placed by Sinclair Refining Co. and W.R. Grace & Co. Each company has ordered a model for 10 passengers. These latest orders will extend Mark 1 *Learstar* production through February 1957.

● The *Helicopter Council* of the Aircraft Industries Association of America now has eleven member companies. The most recent member to join is Doman Helicopters Inc., Danbury, Connecticut. The other members are : Bell Aircraft Corp., Cessna Aircraft Co., Gyrodyne Company of America Inc., Hiller Helicopters, Hughes Tool Co., (Aircraft Division), Kaman Aircraft Corp., Kellett Aircraft Corp., McDonnell Aircraft Corp., United Aircraft Corp., Vertol Aircraft Corp.—The Council's Chairman is Don R. Berlin, President of Vertol Aircraft Corp. ; Vice-Chairman is J.E. Leonard, Manager, Military Sales—Helicopters, Cessna Aircraft Co.

Georges Glasser, President and Managing Director of S.N.C.A. du Sud-Ouest, has been elected President of France's Union Syndicale des Industries Aéronautiques.

W. C. Hammond-Adler has been made European representative of Link Aviation Inc., with offices in Geneva, Switzerland.

French Naval Air Service representatives at N.A.T.O's. " Exercise Thunderhead " held in the Mediterranean from June 25th to 28th, 1956, the biggest Southern European exercise since 1952. Right (with cap) Vice-Admiral Pierre Barjot (author of the article " Naval Aviation in 1956 "); left Admiral Nomy, Chief of Staff, French Navy ; centre Captain Traub, captain of the aircraft carrier *Bois Belleau*.

● *Dr. Theodore von Karman*, Chairman of N.A.T.O.'s Advisory Group on Aeronautical Research and Development, received the Presidential Medal of Freedom, the highest civilian honour that the President of the United States can bestow, at a celebration in Los Angeles commemorating his 75th birthday.

SERVICE AVIATION

● *The veil of secrecy* surrounding the Italian Air Force's missile test centre has been partially lifted by the Rome newspaper " Giornale d'Italia ", which reveals that the centre is located at Predasfocu, in the Nuoro province of Sardinia. The range covers an area of about 155 square miles of uninhabited country. Equipment for the range is being furnished by Contraves Italiana, and the rocket described by " Giornale d'Italia " as undergoing tests is an Oerlikon *Ursula*. Length 19.7 ft., diameter 1.3 ft., launching weight 827 lbs., warhead 44 lbs. The power unit develops a thrust of 2,205 lbs. Max. altitude 50,000 ft.

● *The North Scottish Decca Navigator chain* was officially inaugurated on June 26th, 1956. It comprises four stations located at Peterhead, Lerwick, Butt of Lewis and Kirkwall, with the master station at Kirkwall, Red Slave at Butt of Lewis, Green Slave at Lerwick and Purple Slave at Peterhead.

● *The Canadian Defence Department* has decided, despite initial doubts, to continue development of the CF-105 supersonic fighter. Total costs of the project will amount to $100,000,000, of which $30,000,000 have already been spent.

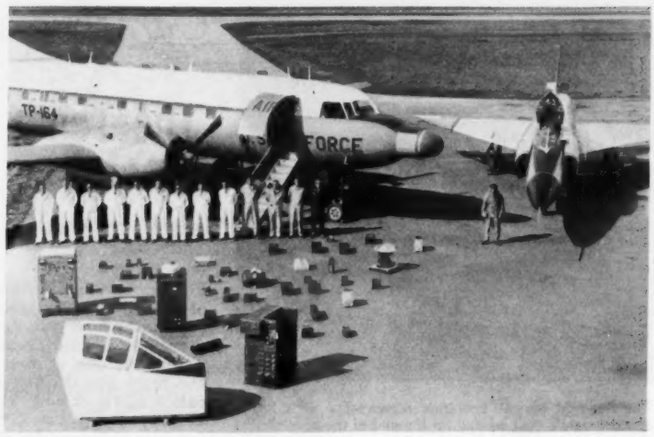
AIRCRAFT AND EQUIPMENT

● Parallel to development of prototypes of its *Mirage I, II* and *III* light interceptors, Générale Aéronautique Marcel Dassault is also working on a series of light ground attack aircraft, designated the *Etendard II, IV* and *VI* (ex Mystère XXII, XXIV and XXVI). The *Etendard II* is a twin-jet model (Turboméca *Gabizo*), the *Etendard IV* has one ATAR E engine, and the *Etendard VI* one Bristol *Orpheus*. By the time these lines appear the *Etendard II* and *IV* will probably have begun flight testing ; the *Etendard VI* is scheduled to fly for the first time towards the end of the year.—The three versions were developed under a construction programme worked out jointly by the French Air Staff and the N.A.T.O. Air Staff. The three versions differ only in the number and type of engines. All three are fitted with low-pressure tyres, to enable them to operate from unprepared fields.

● The type designation of the *Fonceur* ground attack aircraft under development at S.N.C.A. du Sud-Est is *SE.116*. The *Fonceur*, of which two prototypes have so far been ordered, is a light, twin-engine low-wing monoplane with retractable nose-wheel undercarriage and is to be fitted with two SNECMA 12 S piston engines. Plans call for later conversion to Turboméca *Baston* turboprops.

A number of non-American firms have been granted sales rights for the *Aero Commander* twin-engine executive aircraft produced by Aero Design & Engineering Co., Bethany, Oklahoma; Harry von Rautenkranz, Celle-Hanover and Zurich for West Germany, Switzerland and Luxemburg; Babb S.A., Paris, for France, Tunisia, Algeria, Morocco and the French Colonies; Vest Aircraft de Mexico S.A., Mexico City, for Mexico; Aerotransportes Wollkopf, Buenos Aires, for Argentina.

A. M. " Tex " Johnston, Boeing Airplane Co.'s Chief of Flight Test, has been granted the Octave Chanute award for 1956 conferred by the Institute of the Aeronautical Sciences.



To flight test a new electronic control system for the Convair F-102 all-weather fighter Hughes Aircraft Co. is using a replica of the F-102 cockpit, with complete control system, inside the fuselage of a military Convair 240 (left). During flight the second pilot in the F-102 cockpit takes over the controls, while engineers check the functioning of the system. Take-off and landing are carried out by the aircraft's normal pilot. Right: components.

● D. Napier & Son Ltd. is testing a new rocket motor, the *Scorpion NSc.1*, which has been fitted for the purpose in the belly of an English Electric *Canberra*. The *Scorpion* works on liquid propellant.

● Works flight testing of a *Rolls-Royce Tyne* turboprop, fitted in the nose of an Avro *Lincoln*, began on June 28th.

● The price of the *Boeing B-52* eight-jet bomber is now given as $10,000,000. Each of the eight Pratt & Whitney J-57 engines costs $185,000.

● The second prototype of the *Handley Page Herald* feeder airliner is to begin flight testing before the end of the summer.

● The *Northrop F-89H Scorpion* all-weather fighter is armed with both Hughes *Falcon* guided missiles and 2.75-inch rocket projectiles. Max. gross weight is given as 40,000 lbs. plus; span approx. 56 ft., length approx. 53 ft. Two Allison J-35-A-35 jets with afterburners are fitted. —Max. speed in the region of 600 m.p.h., operating altitude 45,000 ft. plus.

● Yugoslavia has a single-engine *FA-2 amphibian* with Lycoming 0-435-A engine and pusher propeller ready for flight testing. The wooden midwing aircraft is said to have been designed by Engineer Fizir.

● Robert McCulloch, President of Temco Aircraft Corporation, Dallas, Texas, announces that his company has been awarded a Navy Bureau of Aeronautics contract for an experimental number of *Temco Model 51* twin-jet trainers, whose *Navy designation will be TT-1*. The aircraft will be built at the company's Wichita plant, and the first will be delivered in July 1957.—Power unit is a Continental YJ-69-T-9 jet of 920 lbs. thrust, though a more powerful engine can be fitted if desired.—Max. speed roughly 300 knots, landing speed 62 knots. With its normal gross weight of 4,400 lbs., the TT-1 has a take-off distance over a 50-ft. obstruction of 3,000 ft.; sea level endurance 1½ hours; service ceiling 30,000 ft.

● *Fokker* announces improvements in the take-off and landing distances of the F.27 *Friendship* turboprop commercial transport. For a gross weight of 33,000 lbs, CAR 4b runway length for take-off is now 3,400 ft. instead of 3,800 ft.; for a gross weight of 34,520 lbs. the figure is reduced from 4,200 ft. to 3,850 ft. Landing field length required (I.C.A.O.—I.S.A. —sea level) is now given as 3,000 ft.

● The *Napier Eland NEl. 1* turboprop has completed its official 150-hour test at a rating of 3,060 e.h.p.

● The *Iroquois* jet designed by *Orenda Engines Ltd.*, of Malton, Ontario, recently completed a 50-hour test bed run.

● The first *Lockheed C-130A* will be delivered to Tactical Air Command, U.S. Air Force, at the end of 1956.

● A *tape recorder* for airborne use to monitor the functioning of electronic fire control equipment is being supplied to the U.S. Air Force by the *Autonetics Division of North American Aviation Inc.* Known as NADAR, the equipment automatically sets itself in operation as soon as the fire control system detects a target. The recorded tapes are examined on the ground after the flight and provide information on the pilot's behaviour etc. during the target tracking phase.—So far more than 850 NADAR systems have been installed in F-86D *Sabre* fighters. Other aircraft to be similarly equipped are the Northrop F-89H, Lockheed F-94C and Convair F-102A. Altogether more than 3,000 NADAR systems and 150 play-back equipments have been delivered.

● The first *Canadair CL-28* (maritime reconnaissance version of the Bristol *Britania*) is in final assembly at Canadair's Montreal plant. It will begin flight testing early in 1957.—The initial R.C.A.F. requirement was for 13 of these aircraft, but this has recently been increased by an order for a further undisclosed number.

Mountain test for helicopters: two SNCASE SE. 3130 *Alouette* gas turbine helicopters and two SNCASO SO. 1221 *Djinn* jet helicopters rendered valuable services in carrying supplies to the training camp for the French Polar expedition in the Vallot Hut (13,300 ft.), near Chamonix. On one occasion a member of the expedition who had fallen seriously ill was transported from the hut with the aid of an experienced mountain guide, despite high winds (gusts up to 60 m.p.h.).

● *Piasecki Aircraft Corporation*, of Philadelphia, Pa., has been awarded a Navy Department contract to build an "experimental vertical lift aeronautical development" nicknamed the *Sea Bat*. It will be an unmanned craft, controlled electronically from shipboard or land bases. Its compactness will permit its operation from small warships, and it can be stowed aboard submarines. The *Sea Bat*, Piasecki explains, will be capable of carrying out missions that cannot be performed by existing aircraft or helicopters.

● It was decided on June 8th to found a *Japan Atomic Energy Research Institute*, construction of which was scheduled to begin during July 1956 at Tokai, Province of Ibaraki. Initial plans call for the purchase of two research reactors from the United States. The first of these, a boiler reactor, is expected to be ready for operation in June 1957, and the contract for the purchase of the second (type CP-5) should be signed shortly. A third reactor is to be developed by Japanese scientists and built in Japan. The type and applications of a fourth reactor will be decided by the Japanese Atomic Energy Commission under the revised long-term development plan for the utilization of atomic energy.

The boiler reactor is to be used initially for training scientists and then for obtaining experience that will be of assistance in designing and building the third reactor. Even before beginning work on the boiler reactor the Institute will carry out a series of experiments with radium and beryllium. Then, with the aid of the CP-5 reactor, it is hoped to acquire a sufficient stock of cobalt isotopes. Funds totalling 600,000,000 yen have been granted for research tasks during the current fiscal year. Some of this total will be used for the purchase of a latest model Van de Graff generator, an analogue computer, a spectograph and other research equipment, as well as the raw materials required (radium, beryllium, uranium, etc.). Altogether the United States is to supply four tons of heavy water and three tons of natural uranium. It is expected that by the end of the five-year development programme the Institute will employ more than 1,000 persons.

The flags of the 57 countries represented at Caracas and delegate's cars waiting for the end of the session.

Caracas...

The Tenth Session of the I.C.A.O. Assembly

by *Interavia's* Special Envoy G. F.

For nearly a month Caracas was the true capital of world aviation. More than 275 civil aviation experts and officials from fifty-seven countries met there for the Tenth Session of the I.C.A.O. Assembly, one of the most important—if not the most important—which this great organization has ever held, since its principal aim was to prepare for the introduction of jet aircraft into the world network and hence for the future of air transportation during the next twenty-five years.

The Venezuelan capital was particularly well chosen since Caracas is experiencing a period of extraordinary development. The some 10,000 oil wells owned by Creole (the Venezuelan Esso) and Shell around Lake Maracaibo pour out over Venezuela a flood of black gold—and of just plain gold—which, thanks to General Marcos Perez Jimenez's Government, is transforming and modernizing both cities and countryside at a breathtaking rate. Skyscrapers are rising up in all directions, motor roads spreading out, crossing mountains and rivers, and airports springing up by the dozen... Venezuela is in a fever, but a healthy fever which, in all fields—social, architectural, human—is enabling it to cover decades in a single year.

These ultra-modern achievements, all of extremely advanced style, seemed symbolically to point I.C.A.O. delegates the way. As Dr. Warner urged in his inaugural address, members must turn resolutely to the future and plan with boldness and imagination.

The advent of jet transports tomorrow will necessitate longer, stronger runways, air terminals capable of handling larger numbers of passengers, navigation aids providing better guidance for aircraft, whether civil or military, and improved traffic control, which may be entirely automatic...

These major—and urgent—needs set technical, economic, financial and political problems which the Assembly tackled with a great deal of realism.

Point 20...

These problems formed " point 20 " on the Executive Committee's agenda. Its appearance on the daily programme blackboard was sufficient to fill the hall.

After the usual somewhat abstract and philosophical discussions, the practical solution was proposed by General Thomas B. Wilson, chairman of the United States delegation. Applying to I.C.A.O. his country's system of " task forces ", a system which bypasses conventional administrative methods... and their slowness, he urged the formation of a special group of experts. The proposal was seconded by Belgium and France and approved almost unanimously. However, Jonathan Keel, chairman of the United Kingdom delegation, opposed it : " Our experience of the *Comets* ", he said in substance, " proved that the operation of jets created no special problems and required no special solutions."

Despite this unexpected statement, the Assembly finally decided to set up a group of six or seven highly qualified experts, to work under the authority of I.C.A.O.'s Council President, who will also be chairman of the group. The latter is to complete its work by the end of 1957.

This is a decision of the utmost importance for the future of air transport. If the Assembly had not taken it, I.C.A.O. would have had difficulty in avoiding disintegration. Some countries, led by the United States, would certainly have withdrawn their membership.

... and the others

Though numerous, all other technical, economic, administrative and legal problems were practically eclipsed by point 20. Even the elections to the Council, despite the last-minute candidatures of Nicaragua and the Philippines, were slightly affected. Nevertheless, they were the subject of many a discussion around, and in, the swimming pool at the Hotel Tomanco (where most of the delegates were housed).

As Germany finally withdrew her candidature, Japan and Sweden were elected to the Council for the first time. Chile and the Philippines were defeated. It should be noted that international politics did not affect the elections.

In fact, thanks to the authority of the committee chairmen, international politics made only brief appearances in the debates. There was, however, a somewhat sharp exchange of

Edward P. Warner (Council President)

S. Pérez Pérez (Venezuela ; Chairman of Tenth Assembly Session)

Carl Ljungberg (Secretary General)

J. E. Keel (United Kingdom ; Vice-Chairman)

K. Matsudaira (Japan ; Vice-Chairman)

General T. B. Wilson (United States ; Vice-Chaiman)

E. M. Loaeza (Mexico ; Vice-Chairman)

W. Binaghi (Argentina)

Caracas, capital of Venezuela, was the scene of the Tenth Session of I.C.A.O.'s Assembly, the first to be held in South America. Delegations attended from 58 member countries. Russia and the Sudan sent observers.

R. Lemaire (France)

A. Garnault (France)

H. Bouché (France)

H. A. Colclaser (United States)

A. Ambrosini (Italy)

G. Marler (Canada)

J. W. Stone (Australia)

R. W. O'Sullivan (Eire)

E. Treu (Austria)

A/V/M Sir Arthur de T. Nevill (New Zealand)

A. Kofoed-Hansen (Iceland)

C. J. Tippett (I.C.A.O. representative in South America)

A. Afia (Egypt)

P. Dai (Executive Committee)

words between Israeli and Arab delegates, a strong protest by the Czech delegation against the launching of propaganda balloons (a definite danger to air navigation) and a plea for the supply of navigation equipment needed for Prague airport (but this equipment is classified as " strategic ") and, finally, formal opposition by the United Kingdom to the proposal to reduce Greece's contribution...

Among the most important resolutions, after the famous " point 20 ", were :

— a resolution recommending coordination of civil and military aviation's use of the air space and of air navigation facilities ;

— a decision to prepare, for a long period ahead and for given types of operations, specifications for runways and taxiways and other physical characteristics of airports ; and to brake the constant increase in the costs of constructing runways by measures such as the adoption of maximums for length and strength ;

— finally, I.C.A.O.'s approval of the organization and financing problems raised by the European Civil Aviation Conference.

It remains for the Council, which met in Caracas immediately after the Assembly session, to apply the decisions and recommendations made by the Assembly and in particular to appoint the experts to the " task force ". It is also to call a new full session of the Assembly in 1959 (in Tokyo or New Delhi ?) and, if necessary, a " small " session in 1957 or 1958.

Between now and then the great international organization, with its annual budget of more than $3,500,000, with its regional offices and its secretariat of over 500 persons, will have to work unceasingly to ensure that air transport shall continue its striking development and fulfil I.C.A.O.'s own forecast of 800,000 million passenger-kilometres a year by 1980.

P.S. Caracas spared no efforts to make the Tenth Session a success. The Venezuelan Government and administration spent months of preparation to ensure that delegations should have every facility for studying the problems on the Council's agenda and to provide a fitting setting for the meetings, exchanges of views and ideas essential to mutual understanding and cooperation. Here tribute should be paid to the efforts and courtesy of Daniel Uzcàtegui Ramirez, head of the Preparatory Commission, Hugo Rojas Moncada, head of the Protocol Department, Santiago Goiri, head of the Coordination and Installations Department, Francisco Carreno Delgado, head of the Public Relations Department, and to all their staff.

Special mention must also be made of Léon Boussard, I.C.A.O.'s Chief of Public Information, whose matchless organization and unfailing charm enabled us to follow the Assembly's work under the best possible conditions.

The caricatures reproduced here were drawn by the well-known Basque caricaturist Otaño for the I.C.A.O. Journal.

Countries elected to the Council

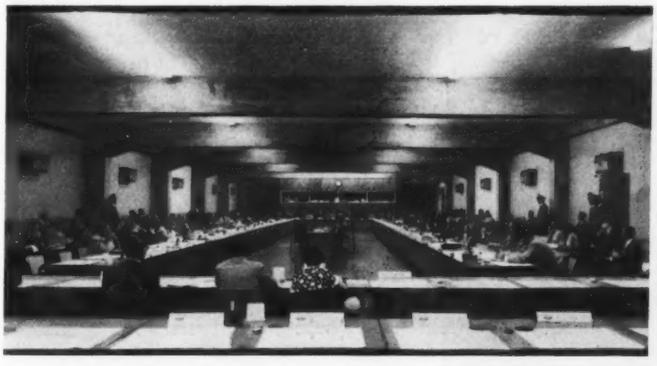
Category A (major air transport countries):
Australia 30, Brazil 40, Canada 44, France 54, Netherlands 42, Sweden 30, United Kingdom 50, United States 54.

Category B (countries otherwise not represented but which contribute the greatest number of facilities for international air transport):
Argentina 46, Belgium 39, Egypt 32, India 35, Italy 35, Japan 29, Mexico 29.

Category C (countries otherwise not represented but whose election ensures Council representation for all principal geographical regions):
Eire 40, Lebanon 47, Portugal 49, Spain 52, Union of South Africa 42, Venezuela 45.

(Figures denote the number of votes. There were 56 voters for category A and 57 for the two others.)

The I.C.A.O. Technical Committee in session. At the end of the hall under the clock are the sound-proof interpreters' lobbies (English, French, Spanish).



Inaugural session in the Aula Magna of Caracas' University library.

The Royal Netherlands Naval Air Service

By Rear Admiral J. M. VAN OLM, Flag Officer, Royal Netherlands Naval Air Service

The Royal Netherlands Naval Air Service was established in 1915 and has become an integral part of the Royal Netherlands Navy. Before World War II it consisted of landplanes, flying boats and some light float-planes. The latter could be embarked aboard ships and catapulted. The main task of the Service was in the Netherlands East Indies, and the deployment of personnel and material was organised accordingly. In particular, the Royal Netherlands Naval Air Service operated from the excellently equipped seaplane and maintenance base Morokrembangan, Java, four other bases in Java, Sumatra, Borneo and Ambon, and numerous auxiliary bases in the Archipelago.

*

On May 10th, 1940, when the Netherlands were unexpectedly attacked by Germany, the Naval Air Service, which had been patrolling along the Dutch coast ever since the outbreak of the war to maintain Dutch neutrality, offered stubborn resistance. Holland surrendered on May 14th. A few hours prior to the capitulation the Royal Netherlands Naval Air Service was ordered to evacuate and join the Allies. Via France, aeroplanes and personnel arrived in the U.K. a few days afterwards. There, equipped with Fokker seaplanes and manned entirely by Netherlands personnel a squadron was formed and integrated as 320 (Dutch) squadron in R.A.F. Coastal Command. As no spares were available in the U.K. for the Fokker aircraft, maintenance was almost impossible and the Squadron was therefore re-equipped with *Hudsons* and stationed in Scotland, for patrol duties against enemy shipping along the Norwegian coast. Just over a year later, the squadron was sent to R.A.F. Station Bircham Newton for low-level shipping attacks along the Dutch coast. Although it suffered losses, the squadron sank 29 ships during these attacks, with a total tonnage of 87,500 tons.

In the meantime the Netherlands government had purchased a number of B-25 *Mitchells*. After being equipped with these planes the squadron was assigned to the Second Tactical Air Force of R.A.F. Bomber Command, and many sorties were flown over enemy territory.

As soon as Japan joined in the hostilities, Royal Netherlands Naval Air Service groups that were in the Far East were brought up to war strength and employed to the full. They suffered very heavy losses against the enemy, who was far superior in strength. When the Netherlands East Indies surrendered, the few *Catalinas* that had survived the battle received a last-minute order to evacuate. They ultimately arrived at Colombo (Ceylon) and were organised into one squadron, 321 (Dutch) Squadron R.A.F., under tactical command of R.A.F. Coastal Command. Reconnaissance and convoy escort flights were made over the Indian Ocean until VJ-day. A detachment, based in Australia, aided the Netherlands guerrillas in the occupied Netherlands East Indies. In addition to the *Catalinas* the squadron was later also equipped with *Liberators*.

Appreciation of the way in which wartime tasks were fulfilled was duly expressed when Her Majesty the Queen of the Netherlands awarded the highest military decoration to the Royal Netherlands Naval Air Service as a whole.

A Sikorsky S-55 helicopter of the Royal Netherlands Naval Air Service about to land on the *Karel Doorman*.

After the liberation of the Netherlands, a completely new organisation had to be set up. As the war had proved once again that anti-submarine warfare is the most important task for the navies of countries dependent on supplies from overseas, the post-war organisation was established with this fact in mind. Besides, the commitments of the Royal Netherlands Naval Air Service in the overseas territories had to be taken into account. For anti-submarine warfare in remote sea areas a carrier-based hunter-killer group was envisaged, whereas the protection of the North Sea was to be carried out by medium-range land-based planes. Beyond that, for the overseas territories in the Far East a squadron of amphibious aircraft was deemed necessary and a squadron of land-based reconnaissance planes for those in the western hemisphere.

During the implementation of these plans, the British escort carrier H.M.S. *Nairana* was obtained on loan for two years. The light escort carrier H.M.S. *Venerable* was purchased from the British and renamed Hr. Ms. *Karel Doorman*. She carried over thirty aircraft (*Fireflies* and *Sea Furies* bought in the U.K.). With British cooperation it was also possible to form a North Sea squadron, consisting of B-25 *Mitchell* light bombers. A squadron of *Catalinas* was stationed in Netherlands New Guinea, and shortly afterwards a squadron of *Fireflies* was stationed in the Netherlands West Indies.

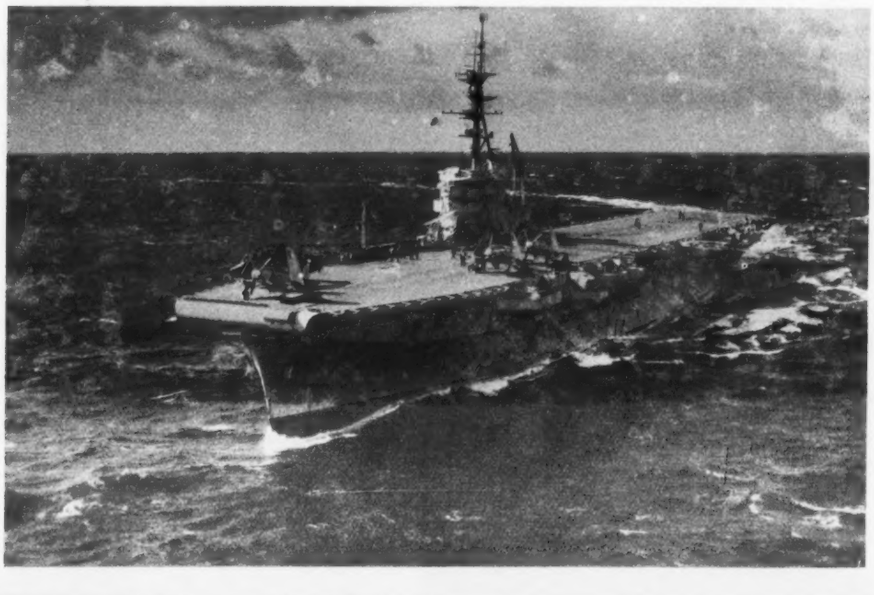
*

When N.A.T.O. came into being, the Royal Netherlands Naval Air Service was immediately able to make a contribution to this organisation, consisting of a light fleet carrier, complete with aircraft, for the protection of shipping routes across the Atlantic Ocean, and a *Mitchell* squadron for protection of the North Sea. The Service now had the task of raising the readiness and the striking power of its forces to as high a standard as possible.

The support that the United States gave, both in material and in training facilities for personnel, has been invaluable. Thanks to the Mutual Defense Assistance Program (M.D.A.P.) the obsolete *Fireflies* were replaced by the more suitable and better equipped *Avengers*. In the same way the B-25 *Mitchells* were replaced by P2V-5 *Neptunes*, thus materially improving the power of the North Sea squadron. Finally the *Sea Furies*, being obsolete, will be replaced in the course of 1957 by *Sea Hawk* jet fighters, ordered in the United Kingdom under M.D.A.P. off-shore procurement.

The re-equipment with modern aircraft has necessitated a modernisation of Hr. Ms. *Karel Doorman*. This is being done now, and in the course of 1957 the Dutch carrier will be back in active service, equipped with an angled deck, a steam catapult and a deck landing mirror. It will then be possible to practise the most modern systems of anti-submarine warfare in N.A.T.O. exercises. It is the opinion of the Royal Netherlands Naval Air Service that N.A.T.O. and other Allied exercises in conjunction with the British and French Navies have contributed greatly to the readiness of the Royal Netherlands Navy. Without these exercises the present state of preparedness of N.A.T.O. naval forces would never have been reached.

The light aircraft carrier Hr. Ms. *Karel Doorman* (13,190 tons) was ceded to the Royal Netherlands Navy by the United Kingdom British name H.M.S. *Venerable*) and is now being modernised (with angled deck, steam catapult and mirror landing sight).



Bréguet Designs for the French Naval Air Arm

A study of recent naval operations reveals that the problem of air cover for ships at sea and reconnaissance of the sea lanes is becoming of increasing importance. The provision of equipment to escort convoys, for coastal patrol and maritime reconnaissance, and not least for submarine hunter-killer operations therefore presents the air-sea warfare experts with tasks of growing difficulty. Other thorny problems include aerial combat at sea, attacks by carrier-based aircraft on surface craft or coastal targets, air transport in support of amphibious landing operations.

This multiplicity of tasks necessarily leads to a multiplicity of projects for their performance. Whereas before the war chief reliance was placed on seaplanes, today preference is given to aircraft with wheeled undercarriages. Long-range patrol duties at sea are undertaken almost exclusively by land-based aircraft, while carrier-based types are used for close reconnaissance, interception of enemy fighters and low-level attacks on naval targets.

*

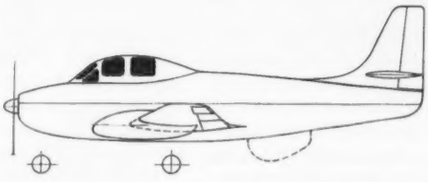
In France, *Société des Ateliers d'Aviation Louis Bréguet* early turned to the design and production of carrier-based aircraft for anti-submarine duties, paying special attention to low-speed qualities such as are needed for deck landings. Here, the wind tunnel at Villacoublay, named after the company's founder Louis Bréguet, was of valuable assistance. It was in this tunnel that the firm's first carrier-based naval combat aircraft, the Bréguet 960 *Vultur*, took shape.

The *Vultur* is powered by two turbine engines, a *Nene* jet in the fuselage rear, and a *Mamba* propeller turbine in the nose.—Through the good offices of the British Government, it was systematically tested and improved at the Royal Aircraft Establishment, Farnborough (where a catapult installation was available), until satisfactory results were obtained. In particular the makers were able to collect a great deal of useful experience of value in the designing of modern naval aircraft [1].

At the time of its conception, the *Vultur* was planned primarily as a naval strike aircraft, but was also to be capable, thanks to its high speed, of engaging enemy fighters. During recent years, however, the speed advantage of both land and carrier-based fighters over the naval strike aircraft has increased on the one hand, and there has been a marked shift in accent in the latter's missions (specialization on submarine detection) on the other.—The combination of these two factors has necessitated a replanning of the naval strike aircraft's equipment, leaving the active protection of this aircraft entirely to carrier-based fighters.

[1] A prototype of the *Vultur* was also recently used to test a new system of boundary layer blowing, which proved to reduce stalling speed substantially.

Bréguet 960-01 *Vultur* prototype with turboprop (A. S. *Mamba*) in the nose and jet (R.-R. *Nene*) in the rear.



Drawing of the Bréguet 1050 carrier-based anti-submarine aircraft, with R.-R. *Dart* turboprop and extensive electronic equipment.

*

The result was the *Bréguet 1050*, a much more economic aircraft than its predecessor since it is fitted with a single engine (Rolls-Royce *Dart RDa. 7* turboprop). In this aircraft the crew is housed in a spacious, sound-proofed cabin which ensures the best possible working conditions.

The new design was first tested in the form of modifications to the second 960 prototype, which was then designated *Bréguet 965*. Meanwhile the Bréguet 1050 has gone into production (reportedly a batch of 100 is to be built), and the first aircraft will go into squadron service in the autumn of this year.

The Bréguet 1050 will have a maximum endurance of four hours and carry efficient electronic equipment, as well as sonobuoys, rockets and depth charges. Its crew will normally comprise three men, with the pilot and first radar observer side by side, and the second radar observer behind them. A folding seat is also provided in the rear of the cabin for a fourth man, if required.

Such teamwork is of particular value in radar duties, since a single observer's powers of concentration are as a rule greatly reduced after about 30 minutes' "screen duty", and he should be relieved. For many other electronic instruments, too, two pairs of eyes and hands are better than one.

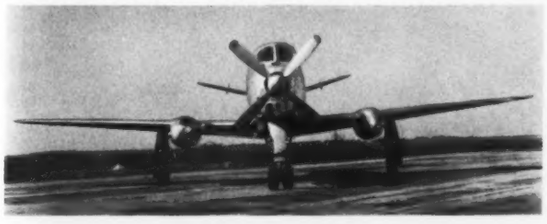
The Bréguet 1050 has a span of 51 ft. 2 ins. (or only 23 ft. with wings folded), a wing area of 390 sq. ft. and a fuselage length of 44 ft. 11 ins. Gross weight is estimated as 18,000 lbs. The retractable undercarriage has a total of five equal-sized wheels, two on each of the main units and one under the nose. The *Dart RDa. 7* turboprop delivers a take-off power of 1,950 h.p. (at 15,000 r.p.m.) and drives a hydraulically controlled four-blade BR. 4 v.p. propeller (Rotol licence). Normal cruising speed is roughly 200 knots, and approach speed for deck landings less than 100 knots.

*

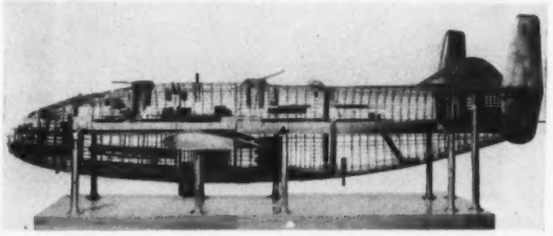
The Bréguet company has also been active in the field of land-based naval combat aircraft for long-range missions and has offered the French naval air service a special version of its well-known *Deux Ponts*. Here radar operators, gun posts and standby crew could be accommodated on the upper deck, leaving the lower free for all heavy special equipment (sonobuoys, depth charges, torpedos, rockets etc.).

The fate of this project has not yet been decided. Nevertheless, 15 aircraft of a *Deux Ponts* military version with increased range have recently been ordered for the transport of troops and supplies in the French Union. The question of building a "navalized" version may therefore perhaps be given fresh consideration.

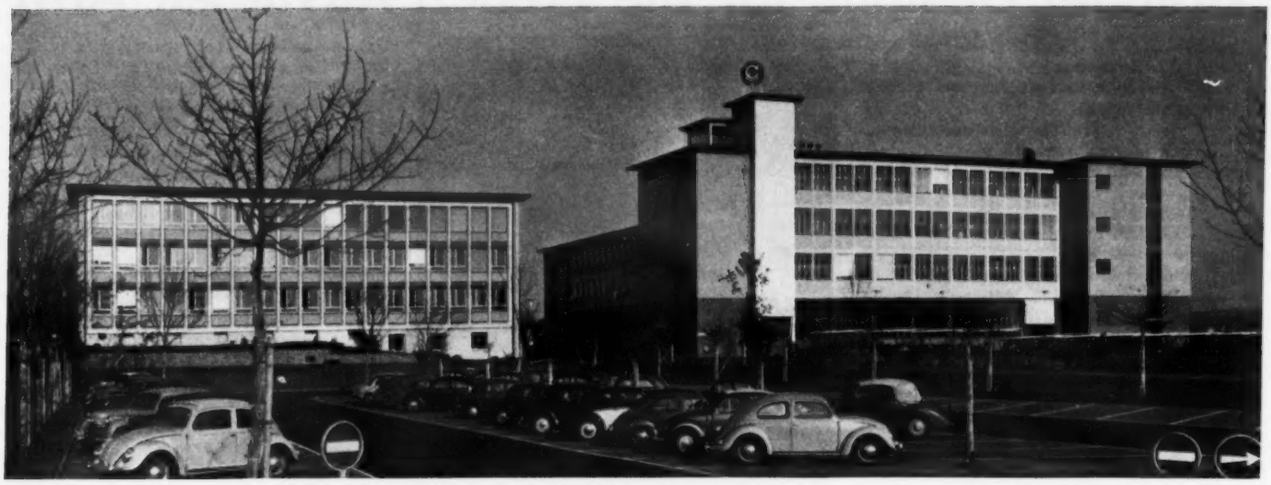
The modified Bréguet 965 prototype (ex 960-02) has only a turboprop; the jet has been eliminated.



Model of the Bréguet 764 *Deux Ponts* land-based naval combat aircraft.



CONTRAVES AG ZÜRICH



View of the new premises

During the first two years of its existence CONTRAVES (Latin: contra aves), founded in 1936 initially as a pure research company, devoted itself to extensive theoretical and technical studies in the field of anti-aircraft artillery, thus laying the actual and potential foundations for its later activities. Shortly before and during World War II it produced its first equipments, which were designed primarily as aids in the gunnery training of anti-aircraft units and have become known under the names of Stereomat, Verograph and Oinoskop. Both in general conception and in engineering, CONTRAVES equipments were unique of their kind and, once certain familiarization difficulties had been overcome, enjoyed a satisfactory demand for the conditions of that time. As the company extended its activities through the practical application of its research results, it enlarged its original operating purposes and was converted into a production and sales organization.

Despite wartime difficulties, CONTRAVES already experienced a first modest boom during these years. Its work won general esteem. However, the immediate post-war years were critical for CONTRAVES, as military orders fell off heavily and the industrial products division just being built up was still too new to balance these losses. The business situation slowly began to improve again in 1948. As ground-based anti-aircraft artillery had been recognized as ineffective against aircraft flying at increasingly high speeds, CONTRAVES developed for both naval and army anti-aircraft units an entirely new type of electronic computer with related gun-laying devices, which is today built in large numbers and which formed the real basis for the firm's present incomparably greater prosperity. In addition to technical improvements to early designs, it was also, and above all, the creation of a high-performance theodolite for tracking moving air targets which was largely responsible for the firm's growth.

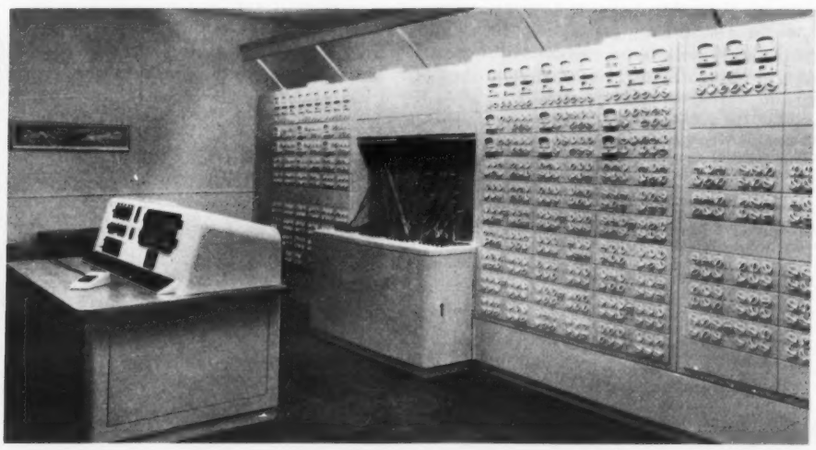
In the civilian field, too, substantial progress has been made through the development of alternating current mains models for the investigation of processes in power distribution systems, of analogue computers, polydromic functions generators, servo controls of all kinds, etc., despite the fact that the company has hitherto been handicapped in its technical and commercial development in this important domain by lack of space.

CONTRAVES has successfully won a place for itself in the world of international competition. A short time ago it was able to move into its own new production plant, laboratories and offices at Zurich-Seebach, largely as a result of its own efforts.

During the past three years CONTRAVES has been obliged to transfer part of its production work to other countries. A plant in Sweden and a subsidiary, CONTRAVES ITALIANA, in Italy produce Contraves equipment, and other countries, such as Belgium, France and the United States, also manufacture Contraves products under licence.

Two CONTRAVES products

EOTS theodolite for tracking moving air targets



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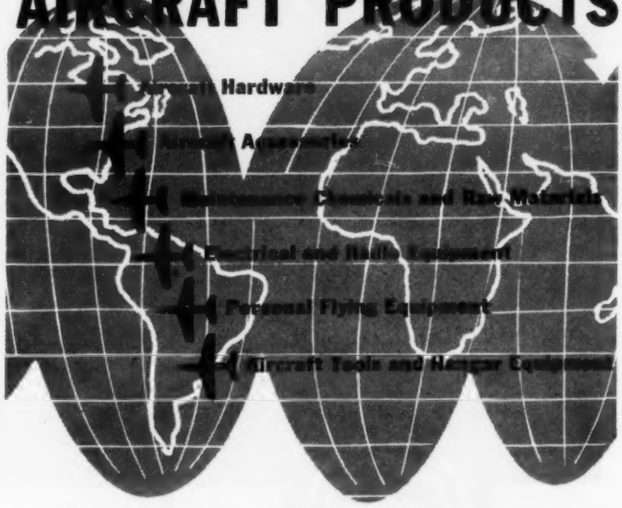

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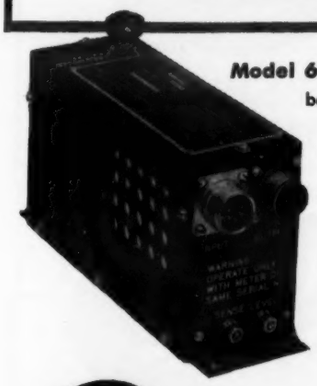

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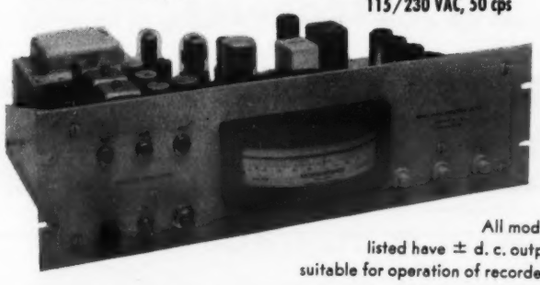

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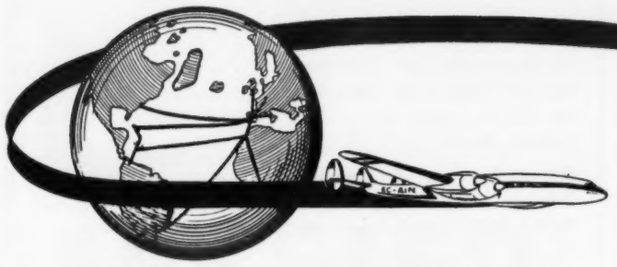

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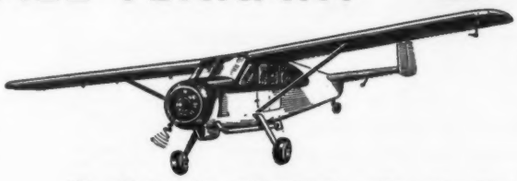

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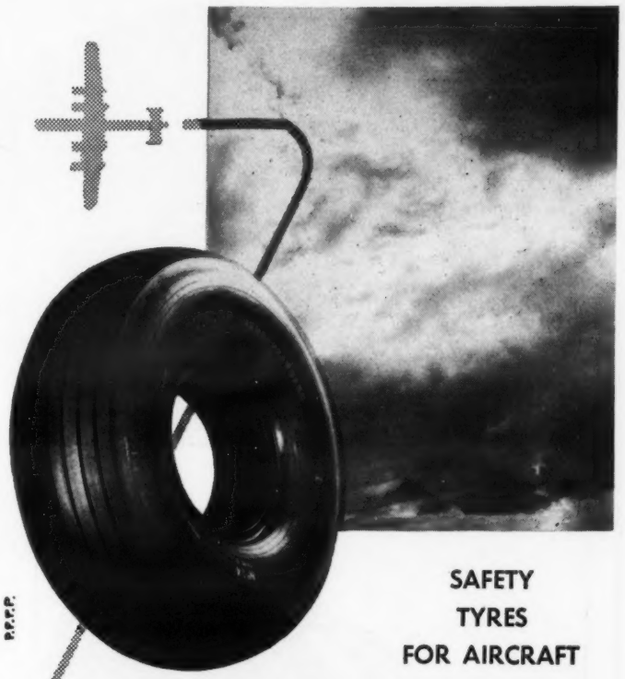

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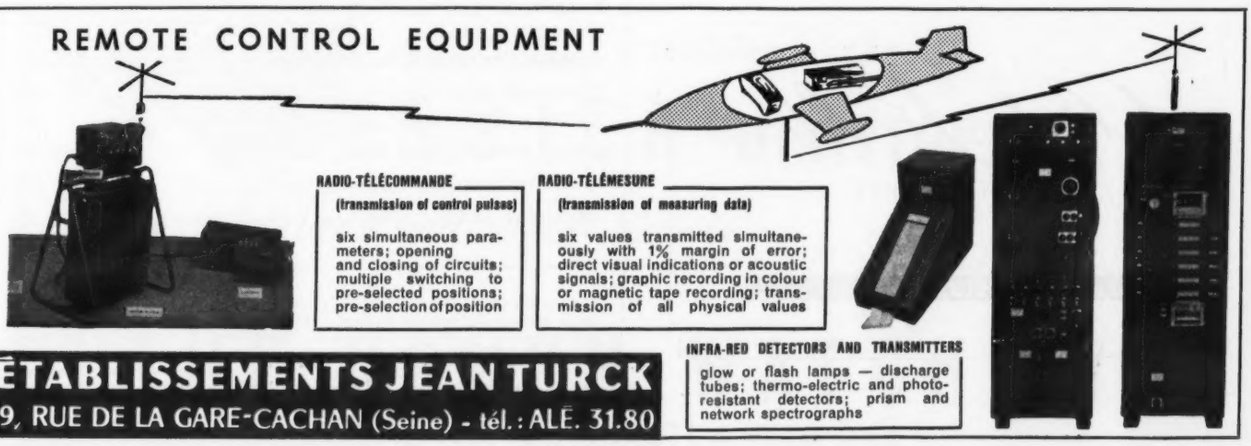

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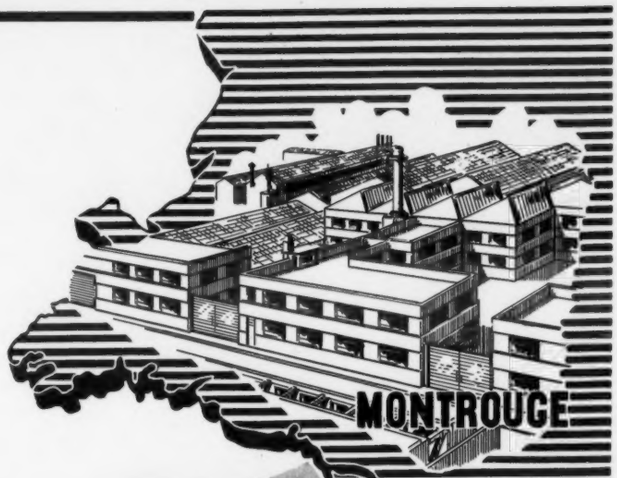

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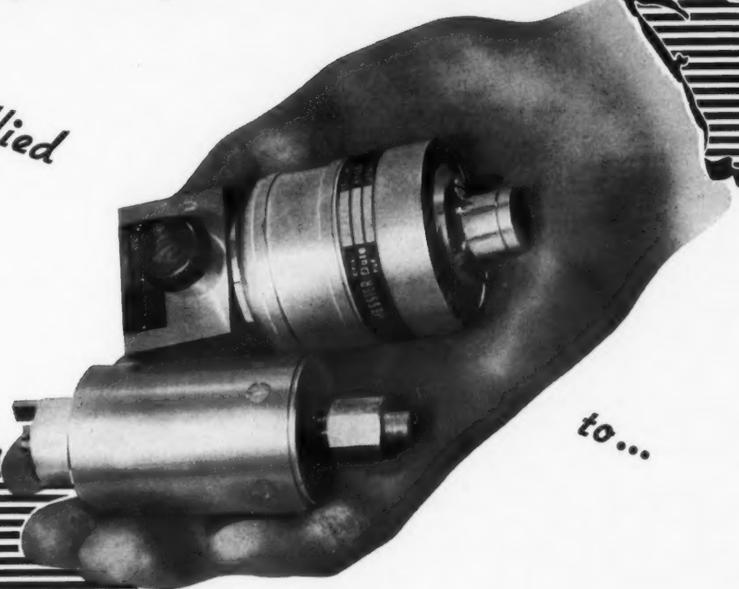

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